REGULATION OF LEAF PRUNING TO OPTIMISE LEAF AND BUNCH HARVEST IN MUSA (AB GROUP) 'NJALIPOOVAN' AND (AAB GROUP) 'PALAYANKODAN'

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DECLARATION

I hereby declare that this thesis entitled "Regulation of leaf pruning to optimise leaf and bunch harvest in Musa (AB group) Njalipoovan and (AAB group) Palayankodan" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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CERTIFICATE

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CONTENTS

		Page No.
INTRODUCTION	....	1-3
REVIEW OF LITERATURE	....	4-33
MATERIALS AND METHODS	....	34-44
RESULTS	....	45-133
DISCUSSION	....	134-158
SUMMARY	....	159-164
REFERENCES	....	165-179
APPENDICES	....	180-188
ABSTRACT	....	189-191

LIST OF TABLES

Sl. No.	Title	Page No.
1.	Effect of leaf pruning on the height of banana cvs. Njalipoovan and Palayankodan.	46
2.	Effect of leaf pruning on the girth of banana cvs. Njalipoovan and Palayankodan.	50
3.	Effect of leaf pruning on the leaf production of banana cvs. Njalipoovan and Palayankodan.	52
4.	Effect of leaf pruning on the phylachron of banana cvs. Njalipoovan and Palayankodan.	54
5.	Effect of leaf pruning on the leaf longevity of banana cvs. Njalipoovan and Palayankodan.	56
6.	Effect of leaf pruning on the functional leaf area of banana cvs. Njalipoovan and Palayankodan.	59
7.	Effect of leaf pruning on the leaf area index and leaf area duration of banana cvs. Njalipoovan and Palayankodan.	64
8.	Effect of leaf pruning on the relative growth rate of banana cvs. Njalipoovan and Palayankodan.	70
9.	Effect of leaf pruning on the time taken for bunch emergence, bunch maturity and crop duration of banana cvs. Njalipoovan and Palayankodan.	73
10.	Effect of leaf pruning on the number of suckers produced in banana cvs. Njalipoovan and Palayankodan.	77
11.	Effect of leaf pruning on the dry matter production in banana cv. Njalipoovan.	80
12.	Effect of leaf pruning on the dry matter production in banana cv. Palayankodan.	85
13.	Effect of leaf pruning on the mean bunch weight, number of hands and fingers of banana cvs. Njalipoovan and Palayankodan.	89

Sl. No.	Title	Page No.
14.	Effect of leaf pruning on the fruit characters of banana cv. Njalipoovan.	95
15.	Effect of leaf pruning on the fruit characters of banana cv. Palayankodan.	100
16.	Effect of leaf pruning on the fruit quality of banana cv. Njalipoovan.	104
17.	Effect of leaf pruning on the fruit quality of banana cv. Palayankodan.	108
18.	Effect of leaf pruning on the nutrient content of banana cv. Njalipoovan.	113
19.	Effect of leaf pruning on the nutrient content of banana cv. Palayankodan.	124
20.	Effect of leaf pruning on the cost of cultivation, net profit and benefit/cost ratio of banana cvs. Njalipoovan and Palayankodan.	129

LIST OF FIGURES

Sl. No.	Title	Between pages
1.	Effect of leaf pruning on plant height of banana cv. Njalipoovan.	47-48
2.	Effect of leaf pruning on plant height of banana cv. Palayankodan.	47-48
3.	Effect of leaf pruning on functional leaf area of banana cv. Njalipoovan.	60-61
4.	Effect of leaf pruning on functional leaf area of banana cv. Palayankodan.	60-61
5.	Effect of leaf pruning on dry matter production of banana cv. Njalipoovan.	81-82
6.	Effect of leaf pruning on dry matter production of banana cv. Palayankodan.	86-87
7.	Effect of leaf pruning on fruit characters of banana cv. Njalipoovan.	96-97
8.	Effect of leaf pruning on fruit characters of banana cv. Palayankodan.	100-101
9.	Effect of leaf pruning on fruit quality of banana cv. Njalipoovan	105-106
10.	Effect of leaf pruning on fruit quality of banana cv. Palayankodan.	109-110

LIST OF PLATES

Sl. No.	Title	Between pages
1 & 2	Effect of leaf pruning on bunch yield of banana cv. Njalipoovan.	93-94
3 & 4	Effect of leaf pruning on bunch yield of banana cv. Palayankodan.	93-94
5	Abnormalities in fruit shape and fruit filling of banana cv. Palayankodan.	101-102
6	Levels of leaf pruning in banana cv. Palayankodan	101-102

INTRODUCTION

INTRODUCTION

Banana is one of the most important commercial tropical fruit crops of India. It occupies an area of 3,25,700 hectares with an annual production of 60,56,400 tonnes which corresponds to 9.75 per cent of the total area and 21.45 per cent of the total production of fruit crops in India. In Kerala, the crop accounts for an area of 22,602 hectares and a production of 3,03,090 tonnes (Anon., 1994). The State occupies the seventh position in banana production within the country. Among the various varieties of the crop grown in Kerala, 'Palayankodan' (Syn. Mysore - AAB group) and 'Njalipoovan' (Syn. Rasakadali - AAB group) occupy a place of prominence. 'Njalipoovan' is the traditional variety of the homesteads of Kerala for both fruit and leaf purpose. 'Palayankodan' is well adapted to Kerala homesteads and due to demand, grown even as mono crop extensively. It is of hardy nature with average fruit qualities.

The leaves are the chief sites of photosynthesis of crop and the total leaf area is usually assumed to be the size attribute that best measures its inherent photosynthetic potential. The partitioning of biomass between vegetative tissue and fruit gives an indication of plant efficiency toward productivity. As Champion (1967) pointed out, the fruit production potential in 'Cavendish' subgroup is about double that of 'Gros Michel'. Only about 10-14 per cent of 'Gros Michel

biomass is fruit compared with about 33 per cent of 'Grand Nain' in Panama. Calculations made in Honduras using 'Grand Nain' indicate that if finger dry weight is compared with harvest dry weight and not total dry weight, a harvest index of 37-43 per cent is obtained. The dry weight of the total foliage produced was about equal to the dry weight of the fingers or about 29 per cent. Thus, both foliage and fingers are equally important in the partitioning process in 'Grand Nain' growing under excellent conditions. 'Grand Nain' has less foliage and therefore more proportion of the flowers are converted to fruit. However, in cultivars belonging to AAB genome, the vegetative growth is more and yield is less compared to varieties of AAA genome (Stover and Simmonds, 1987). Although it is thought that a banana plant produces more leaves than that required for normal fruit development, pruning of banana leaves is not usually recommended as a commercial practice as this is believed to affect bunch development, reduce the green life of the picked bunch and cost extra money labourwise.

Fresh and dried leaves of banana are utilised for a number of purposes in South India. Bananas are grown either exclusively for harvesting leaves or the leaves are taken after the bunches are harvested or sometimes even from the standing plant of ratoon crops. In Maharashtra, farmers retain only 6-8 leaves per plant in 'Basrai' banana plantations and remove the rest of the leaves. According to Robinson and Nel (1989) a leaf

area index of about six at flower emergence represents the optimum leaf cover for maximum yield potential. At higher leaf area index, light and temperature becomes limiting and the cycle time component of yield per annum becomes too long. Pruning of leaves before flower initiation merely delays flowering and cycle time.

Earlier research works on controlled partial defoliation in banana have shown that in AB and AAB group dessert bananas, the proportion of the economic part is comparatively lower and limiting the vegetative growth will enable the bunch to be the sink for the nutrients. Thus, through leaf pruning it may be possible to direct more energy towards bunch development than to support supra optimum vegetative growth. The leaves thus removed can fetch additional returns by way of sale in the local markets for use as leaf plates. The domestic demand for banana leaves, now, is mainly met from outside state sources.

The present study was therefore undertaken to regulate the vegetative growth of the banana plant to create a balance between the growth of the vegetative and economic parts. The findings emanating from of the study will provide valuable information about the extent of leaf area that can be sacrificed without affecting yield and quality by way of removal or disease incidence. This information will also support decisions on leaf disease management strategies.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Banana growth is largely a function of the number of leaves (Simmonds, 1966). A banana plant produces more leaves than that is required for normal fruit development since this enables the plant to build up a strong pseudostem frame work capable of supporting the bunch (Stover and Simmonds, 1987). The banana plant may need to develop a large leaf area during the pre-floral phase to increase the potential to set a large bunch (Turner, 1980; Krishnan and Shamugavelu, 1983 and Stover and Simmonds 1987). However the role of post-floral leaf area in determining the final yield potential of banana is less clear (Robinson et al., 1992).

Partial defoliation studies have been conducted in banana by a number of research workers in order to find out the optimum leaf area for optimum growth and development of the crop. The results of such studies in banana and other crops are summarised below.

2.1 Effect of leaf pruning on growth characters

2.1.1 Effect of leaf pruning on plant height and girth

Basu (1901) reported that intensive leaf pruning from the hardy 'Athia' banana variety of Assam reduces the growth of

the plants. On the other hand Hartman and Bailey (1929) observed increased plant height due to defoliation in some instances in banana.

According to Pillai (1975), retaining either 6, 9, 12, 15, 18 or all leaves in 'Poovan' banana until flowering affected plant growth. Plants with all the leaves significantly produced maximum mean height followed by plants with 15 and 18 leaves. Lowest mean height was recorded in plants with 6 and 9 leaves.

Martinez (1984) reported no effect of defoliation on either plant height or girth of banana var. Dominica Harton. In 'Basrai' banana plants, the height increased as the number of functional leaves per plant increased (Kothavade et al., 1985). According to Satyanarayana (1985), in 'Basrai' banana, different levels of functional leaves did not influence plant height significantly.

Pillai and Shanmugavelu (1977) reported that the mean girth of the corm decreased with the increase in the number of functional leaves. Satyanarayana (1985) observed that the retention of all functional leaves recorded the maximum plant girth. There was a decreasing trend in many of the growth parameters such as height, girth etc. by decreasing the number of functional leaves.

Effect of defoliation on other crops also are reported by research workers.

In 'Gordo' grapevine, Buttrose (1966) reported that the trunk was least affected by leaf reduction followed by shoot, berries and roots. The minimal leaf area for unimpeded growth of aerial organs was estimated to be 1500 sq. cm (12 leaves). A fall in leaf number resulted in a longer lag phase and a shorter second growth phase. Growth rate in second phase was not greatly affected.

Sourial and Meligi (1976) reported reduced cane length in 'Thompson Seedless' grapes due to defoliation. Fournioux and Bessisi (1980) observed that in grape vine cv. Pinot, defoliation twice a week during a vegetative cycle led to shortened internodes so that shoot growth was less than in leafy vines. Relative differences in the elongation potential of internodes because of their position on the plant were not affected by defoliation. The duration of active growth period was not affected but it was followed by a month of slow growth in defoliated vines which did not occur in leafy vines. Todorov and Mievska (1984) stated that constant leaf removal caused a greater size reduction in tissues of 'Italian Reisling' grapes with adverse effect on vascular bundles.

In young mango plants Parisot (1988) observed that removal of leaves as soon as they reached 5 cm in length resulted in suppression of rhythmic growth.

In dry bean, Wallace and Munger (1965) suggested that leaf area ratio may be the chief factor responsible for growth differences.

In maize, Crockett and Crookston (1980) reported that defoliation reduces tillering.

2.1.2 Effect of leaf pruning on leaf characters

There are pronounced differences in the photosynthetic efficiency of banana leaves due to leaf age (Gietema - Groenendijk, 1970), leaf water potential (Ke, 1980), cultivar (Stover and Simmonds, 1987) and light intensity (Robinson and Nel, 1989).

Hartman and Bailey (1929) reported complete recovery of the leaf surface after defoliation in some instances in banana. Summerville (1944) reported that phylachron in banana was 7 days under tropical conditions. In 'Poovan' it varied from 8 to 8.6 days. Phylachron decreased with increase in plant age (Champion, 1963). Pillai and Shanmugavelu (1976) observed that in 'Poovan'

banana, defoliation did not affect total leaf production. Phylachron decreased with the increase in the number of functional leaves. Highest total leaf area was recorded from plants which retained all leaves.

Turner and Hunt (1987) reported that in 'Williams' banana, complete defoliation at 15 and 25 leaf stages resulted in the production of an extra 3-4 leaves before bunch emergence. Defoliation did not change the number of leaves produced by ratoon crops. Complete defoliation at 35 leaf stage reduced the number of live leaves at harvest from 5.2 to 4.1.

2.1.3 Effect of number of leaves produced on flower initiation and flowering

There exists 2 different views on the relationship between leaf production and flower induction in banana. One view is that a reasonably constant number of leaves emerge prior to floral initiation (Ticho, 1960; Wardlaw, 1972 and Champion, 1963) and the other view is that the number of unemerged leaves inside the pseudostem at floral initiation is fairly constant (Summerville, 1944 and Champion, 1961). But both these views are based on the production of a fixed number of leaves in total. The total number of leaves produced per plant may vary from 23-50 depending upon cultivars (Turner, 1970 b).

Summerville (1944) formulated an arithametical model for determining bunch initiation. He recognised flowering as a function of total expanded leaf area, the exposure of each leaf to sufficient hours of day light and the mean temperature during the functional life of each leaf. When the product of these (Ts) reached a threshold value, the bunch was initiated. From the examination of the data of Summerville, bunch initiation occurs at Ts of 5.6×10^{11} whereas differentiation occurs at Ts 6.3×10^{11}. However, Barker and Steward (1962) do not favour this as a generally applicable hypothesis. Simmonds (1966) regards the concept as a crude measure of net assimilation or of some metabolic rate. However Ts values have never been verified experimentally in the tropics. Later, an attempt was made to find out the applicability of Ts concept in the banana cv. Poovan by Pillai and Shanmugavelu (1976). The highest Ts value was observed in plants which retained the highest number of functional leaves and the lowest value was observed in plants which retained the minimum number of functional leaves.

Hartman and Bailey (1929) reported that defoliation in banana delayed shooting in some instances. Summerville (1944) found that eleven leaves remained within the pseudostem of 'Dwarf Cavendish' banana when the bunch could be detected with a hand lens. Dumas (1955) reported that slow growing 'Dwarf Cavendish' type at French Guinea and France, produced 33-38

leaves and apparently initiated its inflorescence on the production of 25th leaf. Ticho (1960) reported that in Israel, 'Dwarf Cavendish' banana initiated its inflorescence on the production of 23rd leaf. Champion (1961) found 10 to 12 leaves remaining within the pseudostem of cv. Poyo at bunch initiation.

Ram Mohan et al. (1962) stated that in banana plant, lower number of functional leaves delayed flower bud differentiation. Barker and Steward (1962) found 9 to 11 leaves within the pseudostem in 'Gros Michel' when the bunch could first be detected and recorded a total of 45 leaves on bunch initiation. According to Champion (1963), while in the development of any one plant, a certain leaf area must be produced before bunch initiation occurs, in a population the vegetatively largest is not necessarily the first one to throw a bunch.

Naik (1963) reported that the total number of leaves per plant before bunching has been worked out to an average of 25 in 'Chakrakeli' (white) and 'Mauritius', 27 in 'Poovan' and 29 in 'Bontha'. Simmonds (1966) estimated that 60 to 70 leaves are produced prior to flowering in banana. Turner (1970b) suggested that approximately 11 unemerged leaves are present in banana, irrespective of the stage of development.

Nambisan (1972) stated that pure acuminata clones produced significantly lower number of leaves than predominantly acuminata hybrids. Among the predominantly acuminata hybrids, 'Poovan' produced the lowest number of 31.8 leaves followed by 'Nendran' (38.4 leaves) and 'Ney Poovan' (41.2 leaves).

Samuel (1972) reported that 24 leaves are produced in 'Robusta' banana prior to flower initiation and eight to thirteen leaves are retained at the time of shooting. Healthy 'Gros Michel' plants have eleven to fourteen or more intact leaves at shooting and twelve to sixteen of the upper pseudostem sheaths (Wardlaw, 1972).

Pillai and Shanmugavelu (1977) reported that floral initiation was delayed in plants maintained with 6 and 9 functional leaves whereas it was earlier in treatments with higher number of functional leaves in 'Poovan'.

Stover (1979) found that floral initiation took place after 26-31 leaves (recorded from the time a peeper was 12 cm tall) were produced in 'Grand Nain'. This was in close agreement with studies by Ganry (1973) and Lassoudiere (1977). At the time of floral initiation, an average of 11.9 leaves remain in the pseudostem.

Satyanarayana (1985) reported that in 'Basrai' banana, retention of all functional leaves recorded the shortest duration to flowering. In a contradictory report, Kothavade et al. (1985) observed delayed flowering in 'Basrai' banana due to retention of all functional leaves. In general, it is reported that pruning of banana leaves before flower initiation delays flowering.

Research workers have reported the effect of defoliation on the flowering of other fruit crops.

In grapes, Gardner et al. (1952) reported that pruning does not influence flower initiation. May and Antcliff (1964) in 'Sultana' grapes and Shanta and Rao (1969) in 'Anab-e-Shahi' grapes have reported similar results.

In papaya, Awada (1967) reported that when hermaphrodite plants were defoliated in February when carpellodic types of flowers appear in greatest quantities, male sex expression was promoted.

In citrus, Randhawa and Srivasta (1986) reported that terminal shoots of almost all the flushes in 'Hamlin' Sweet Orange showed more shoot length and leaf area per shoot than the laterals and the number of flowering shoots was greater in terminals than in laterals.

In pecan trees, the total number of pistillate flowers decreased with the earliness in defoliation. It was highest in non-defoliated plants (Medina et al., 1987).

In crops other than fruits also, defoliation has been found to affect flowering.

In maize, Crookston and Hicks (1978) observed that defoliation can be used to modify the flowering date.

In sugarcane, when four cultivars were pruned weekly from August to October, the removal of old leaves had little effect on flowering whereas the removal of young leaves (during the second half of August and the first week of September) delayed flowering in three cultivars. The treatment completely inhibited flowering in INCA III and C 2515-76 and affected inflorescences in CP 5243 and C 18985-74 (Sam and Iglesias, 1987).

Sudhakara et al. (1989) found no adverse effect of leaf removal on female flower production of West Coast Tall coconut.

2.1.4 Effect of leaf pruning on bunch maturity, harvest and crop duration

Hartman and Bailey (1929) reported that if banana plants are defoliated before shooting, the bunches were less

affected than those defoliated after shooting. Fruits of defoliated plants took longer time to reach a certain standard size and were more mature than was usual for that age.

Ticho (1960) described a technique used in Israel to control the timing of harvest. It involved setting the sucker during the summer months and regulating its growth to avoid the inflorescence differentiating during the winter. The suckers were defoliated before the winter if they were too large. This delayed differentiation of the inflorescence and hence harvest. Turner (1970a) found that the four leaves preceding the flowers influence the maturation of the bunch. Wardlaw (1972) stated that any circumstance which decreased the functional leaves is liable to have an adverse effect on bunch formation and its development to maturity. Premature defoliation due to Sigatoka leaf spot induced fruit ripening in the field and ten healthy leaves were required at flowering or four at harvest to prevent this occurence. (Stover, 1974 and Ramsey et al., 1990).

Pillai (1975) reported that the period of maturity of bunches from shooting was early in plants with more number of functional leaves. Total cropping period was considerably less in plants which maintained all leaves or a minimum of eighteen leaves, while it was more in plants which maintained nine leaves in 'Poovan' banana.

Kothavade et al. (1985) reported that due to the retention of functional leaves in 'Basrai' banana, flowering and hence harvesting was delayed. In 'Williams' banana, removal of more than 75 per cent leaves induced stress in the plant crop and reduced the green life of the bunch and led to possible bunch scorch. (Anon., 1988). Turner and Hunt (1987) observed that in 'Williams' banana, complete defoliation of the plant crop at the 5 leaf stage had no effect on the harvest of the plant crop but delayed bunch harvest in ratoon crops by 2 months due to delayed development of ratoon suckers. Complete defoliation at 15 and 25 leaf stages in the plant crop produced an extra 3-4 leaves before bunch emergence and consequently a delayed harvest. Defoliation at 15 and 25 leaf stages was effective in delaying harvest in plant crop but not in ratoon crop. Robinson et al. (1992) reported that in 'Williams' banana, field ripening of bunches did not take place as a result of defoliation.

According to Singh and Bhattacharya (1992) reduction in phylachron exerted considerable influence in reducing overall crop duration in banana.

In grapes, Sourial and Meligi (1976) showed that 'Thompson Seedless' grapes required a leaf surface area of about 2200 sq. cm. (12 leaves) for the development and maturation of each fruit bunch, that is 8 sq. cm. leaf area per gram of fruit.

Maturation was delayed in bunches provided with 1500 sq. cm leaf area although they reached normal weight.

2.1.5 Effect of leaf pruning on sucker production and sucker growth

Ploidy and genomic blood are considered as the two major general characters determining sucker production (Stower and Simmonds, 1987).

Venkataramani (1946) recorded more number of suckers in Musa balbisiana derivatives and less number of suckers in Musa acuminata derivatives. Musa balbisiana clones have been reported to produce larger number of leaves as compared to Musa acuminata clones (Nambisan, 1972). Sucker production is less in triploid banana (Gregory, 1954 and Shanmugavelu and Balakrishnan, 1980).

Turner (1970b) reported that in 'Williams' banana, rate of sucker growth and plant water relations were affected by defoliation. Sucker growth was highest when 2-3 leaves remained on the parent plant. According to Turner (1976), sucker emergence was dependent on the stage of development of the parent plant. Plants which had not produced at least 12 leaves would not throw suckers.

Chakraborthy (1977) reported that production of suckers was high in 'Monthan' (ABB) and also 'Robusta' (AAA). Alakiamanavalan (1979) observed profuse suckering in the cultivars of AA genome.

Stover and Simmonds (1987) reported that when defoliation in the mother plant left as few as seven leaves at flowering, ratoon sucker growth of 'Valery' and 'Grand Nain' bananas were accelerated. They suggested that increased light penetration may be the causative factor.

2.1.6 Effect of leaf pruning on biomass and dry matter production

According to Berrill (1956), throughout the life of the banana plant, starch, sugars and proteins are manufactured in leaves and pseudostem, and some of these are used directly in the growth process of the plant and its developing suckers and the balance is stored in the corm. After shooting, the reserve food material becomes available to meet the requirement of bunch and flowers. Martin-prevel (1967) suggested that during the life time of a banana plant, corm accumulates starch in storage tissues, but the major mineral nutrients were not stored to any extent.

According to Champion (1967) the partitioning of biomass between vegetative tissue and fruit gives an indication of plant efficiency in the production of fruit. The fruit production potential in the 'Cavendish' group is about double that of 'Gros Michel' . Only about 10-14 per cent of 'Gros Michel' biomass is fruit compared with about 33 per cent of

'Grand Nain' in Panama. Calculations made in Honduras using 'Grand Nain' indicate that if finger dry weight is compared only with harvest dry weight and not total dry weight, a harvest index of 37-43 per cent is obtained for 'Cavendish' varieties. The dry weight of the total foliage produced was about equal to the dry weight of the fingers or about 29 per cent. Thus both foliage and fingers were equally important in partitioning process in 'Grand Nain' growing under excellent conditions (Stover and Simmonds, 1987).

Sheela and Aravindakshan (1990) noticed a progressive increase in total drymatter content of banana cv. Palayankodan with age of the plant and it was most rapid between the late vegetative phase and shooting time. This was because the plant showed a very high rate of growth during the period.

2.2 Effect of leaf pruning on yield characters of banana

2.2.1 Effect of leaf pruning on bunch size, weight and yield of banana

Hartman and Bailey (1929) conducted controlled partial defoliation experiments in banana and observed that the younger the bunch was at the time of defoliation, the greater was the loss in bunch weight. The correlation between bunch weight and leaf area was also reported by Croucher and Mitchell (1940).

Murray (1960) established a correlation between the size (length and breadth) of the third leaf at the age of 6 months and the final bunch weight in a plant crop of 'Dwarf Cavendish' banana. Lossois (1964) showed a high correlation between yield and the circumference of the pseudostem at flowering. An undesirable effect of defoliation treatment would be a reduction in fresh weight of the bunch especially if defoliation took place too close to bunch emergence (Leigh and Sproule, 1967).

Turner (1970a) reported that in 'Williams' banana, leaf length duration (leaf length x longevity) was related to bunch weight positively. Yield was markedly affected only when less than four leaves were retained after flowering. The four leaves preceding the flower influenced the weight and maturation of the bunch. Turner (1970b) reported that increase in leaf area in the ratoon crops did not result in increased production. However this decline may be related to incidence of pests and diseases particularly nematodes.

Pillai and Shanmughavelu (1978) reported that in 'Poovan' banana, bunch weight was positively correlated with functional leaf area. Maintaining 12-18 leaves was found best for optimum yields.

Leaf area is an important index of vigour which influence the consequential yielding capacity of a banana cultivar. (Chakrabarthy and Rao, 1980). The banana plant may need to develop a large leaf area during the pre-floral phase to increase the potential to set a large bunch. (Turner, 1980 and Stover and Simmonds, 1987). Krishnan and Shanmugavelu (1983) reported that in 'Robusta' banana, the total number of leaves had a positive association with bunch weight but the effect was not significant.

Martinez (1984) studied the effect of defoliation on yields in the first two harvests in banana plants continually defoliated to leave 4, 6, 8, 10 or 12 leaves per plant. Yields were similiar in control non-defoliated plants and in plants defoliated to leave a minimum of 8 leaves per plant. Defoliating to leave 4 and 6 leaves per plant reduced yields by 50 and 32 per cent respectively in the first harvest and by 50 and 40 per cent respectively in the second harvest. Kurian et al. (1985) observed that in 'Nendran' banana, the number of functional leaves per plant had a positive direct effect on yield, but the rate of dependence was too small.

Kothavade et al. (1985) reported that in 'Basrai' banana as the number of functional leaves per plant increased, the weight of the bunch was progressively increased. Maximum

bunch weight was recorded from plants which retained all the functional leaves.

Sathyanarayana (1985) reported that in 'Basrai' banana, retention of all functional leaves produced the heaviest bunches, statistically superior to retention of 10, 8 and 6 leaves. The effect of retention of 16, 14 and 12 functional leaves was on par with that of the retention of all functional leaves in succession. Since the influence of 12 functional leaves was on par with that of all functional leaves, this is considered as the minimum foliage essential for optimum yields of 'Basrai' banana. Daniells and O'Farrell (1987) were able to manipulate ratoon sucker yield in banana by excising the parent pseudostem at different heights. Ratoon sucker yield was reduced by severe pruning.

Turner and Hunt (1987) reported that in 'Williams' banana, complete defoliation at the 35 leaf stage reduced bunch weight and the production of fresh fruits by about 30 per cent. Removal of 50 or 75 per cent of the total leaves did not adversely affect bunch mass in the plant crop of 'Williams' banana. With increased severity of leaf pruning, yield of ratoon crop (bunch mass and finger length) were affected (Anon., 1988). The threshold leaf number at flowering was 9 above which bunch mass increased only slightly but below which bunch mass dropped

sharply. Robinson et al. (1992) reported that in 'Williams' banana, bunch mass was not influenced by different levels of pruning in the plant crop but was significantly reduced in two ratoon cycles by severe pruning.

Research workers have studied the effect of defoliation on other fruit crops also.

In grapes, Winkler (1954) observed that heavy pruning of vinifera grape vines leading to great reduction in total leaf area limited fruit setting in the vine due to lack of carbohydrates. In 'Red Muscat' and 'Aligote' grape vines, Todorov and Zankov (1965) reported that the retention of leaves on the lateral branches increased bunch and berry size. Purohit et al. (1979) reported that bunch weight increased in 'Anab-e-Shahi' grape with increasing leaf area per bunch. The maximum size and weight of the berries were obtained when 15 leaves were left to a bunch giving an area of 3064cm^2. Fournioux and Bessisi (1980) reported that in grape vine cv. Pinot, as a result of defoliation twice a week during a vegetative cycle, inflorescence development was followed by complete fruit set failure. Lorenzo and Sottile (1984) studied the behaviour of grape vine cv. Cataratto lucida defoliated at harvest. Average bunch weight was significantly reduced after 30 and 100 per cent leaf removal as compared with non defoliation. The reduction in bunch weight

after 60 per cent leaf removal was not significant. Macek and Malus-Rozman (1987) reported that in grape vine cvs. Rumeni Plavec, Zametna Crnina and Kraljevina, dates of defoliation had no significant effect on grape yield. A significant effect of leaf area on yield was found only in cv. Zametna Crnina. In 'Sauvignon blanc' grape vine, yield was not significantly affected by different levels of leaf removal or timing of leaf removal. Shanmugavelu (1989) stated that the leaf area on the previous season shoots and the current season shoots both influence the size of berries on the vine. The disposition of the leaf in relation to bunch position is also an important factor determining berry yield. The presence or absence of leaves below the bunch appeared to influence the bunch development more than those above the bunch.

In pea, if the leaf area per hectare at flowering was increased by a higher sowing rate on more favourable weather, the yield was enhanced. (Kornilov and Kostina, 1965).

In pear var. Precoce di Altedo, Fregoni and Roversi (1966a) recommended leaving one fruit per 40 to 50 leaves in order to obtain a good yield without undue reduction of fruit size. In pear var. 'Williams', leaving one fruit per 60 leaves was found to be the best for optimum yield.

Fregoni and Roversi (1966b) found that in apple varieties Imperatore, Stark Delicious and Campanino, fruit size and weight were increased with increasing number of leaves per fruit. For optimum yield and fruit size, the recommendation for 'Imperatore' is slightly less than 30 leaves per fruit, for 'Stark Delicious' 30 leaves per fruit and for 'Campanino' more than 30 leaves per fruit.

In 'Kew' pineapple, the number of leaves at one year after planting is a good index of fruit weight and yield potential (Chadha et al., 1977).

Similar studies conducted in other crops gave the following indications:

In 'Harvester' snap bean, Greene and Minnick (1967) reported that yield reduction began somewhere between 33 per cent and 50 per cent defoliation twice, during flowering or pre-flowering stage.

Hardon et al. (1969) found significant correlation between leaf area and bunch yield in a number of progenies of oil palm.

In cassava, Sinha and Nair (1971) observed that only those cultivars which have larger leaf area and leaf area index

were high yielders. According to Ramanujam (1983), for high yield of cassava cultivars, optimum leaf area index should be maintained for a longer period. Similar results were obtained by Paramaguru and Thamburaj (1991).

In coriander cv. PS 360, leaf plucking significantly reduced seed yield (Bhati, 1988).

In tomato cvs. Calypso and Dombito, different intensities of weekly leaf removal was compared so that 15, 18,21 or 24 leaves per plant remained, by Buitelaar (1989). Differences in yields per square metre and average fruit weight were not significant. In a trial in which 0, 3, 6, 9 or 12 leaves were removed, the yield per square metre was adversely affected by the most severe defoliation treatments.

In 'West Coast Tall' coconut, Sudhakara et al. (1989) reported that removing one, two or three oldest leaves in successive or alternate months in the summer had no adverse effect on nut yield.

2.2.2 Effect of leaf pruning on fruit characters

Berril (1956) showed that poor filling of banana fruits can be prevented if the plants have an efficient root system and a large healthy crown of leaves.

Pillai and Shanmugavelu (1978) reported that in 'Poovan' banana, the mean number of hands and fruits in the bunch increased with increase in the number of functional leaves. The length of the rachis, pedicel length, weight, volume, length of fruit, peel weight and pulp weight of the fruit increased with increase in the number of functional leaves. Pulp/peel ratio was highest when the lowest number of six functional leaves were retained.

Satyananarayana (1985) reported that in 'Basrai' banana, retention of all functional leaves recorded the maximum number of hands and fruits of better size. Turner and Hunt (1987) observed that in 'Williams' banana, complete defoliation at 35 leaf stage reduced the number of hands per bunch by 19 per cent, the number of fruits per bunch by 16 per cent, the number of fruits per hand by 7 per cent and finger weight by 16 per cent.

Robinson et al. (1992) stated that in 'Williams' banana, there was no adverse effect of controlled leaf pruning at flower emergence on finger length of plant crop. In the first ratoon cycle, finger length declined progressively with increasing severity of leaf pruning.

In grapes, Aravindakshan and Krishnamurthi (1969) reported that the total defoliation of shoots resulted in the production of seedless berries. This was found prominently in

the variety Habshi. However the exact reason for the production of seedless berries could not be given.

2.3 Effect of leaf pruning on fruit quality

Wardlaw (1972) reported that healthy 'Gros Michel' banana plants have 11 to 14 or more intact leaves at shooting and 12 to 16 of the upper pseudostem sheaths and these leafy conditions stand in a close and direct relationship to fruit quality.

Pillai and Shanmugavelu (1978) observed that in 'Poovan' banana, fruit quality in terms of TSS, total sugars, reducing sugars, sugar/acid ratio etc. was positively related with functional leaf area. Rajaram (1980) reported drastic reduction in fruit quality due to reduction in effective leaf area. Kothavade et al. (1985) reported no significant difference in the quality of 'Basrai' banana fruits due to defoliation when upto eight leaves were retained 180 days after planting.

Robinson et al. (1992) reported that the pre-climacteric storage life of mature banana fruits was shortened when less than five leaves were present on the plant at flowering. Between five and twelve leaves produced no apparent extension in fruit storage life. With only one or two leaves,

most fruits started softening rapidly seven days after harvest, while some fruits remained hard. There was about a two day extension of time to 50 per cent soft for fruits from plants with more than four leaves compared with those having one or two leaves.

In grapes, leaf area strongly influences fruit quality. Overcropping in grapes is generally associated with fruits of poor colour (Winkler, 1954; Shaulis and Robinson, 1953; Weaver et al., 1957 and Koblet, 1967). Loomis and Lutz (1957) found that 'Concord' grapes had very good colour with 5m^2 leaf area per vine while with 2 m^2 or less of leaf area per vine, the fruits were always poor in colour. Todorov and Zankov (1965) reported increased sugar content of berries in 'Red Muscat' and 'Aligote' grape berries due to retention of leaves on the laterals. Koblet and Perret (1971) studied 'Riesling' x 'Sylvaner' vines and showed that grape sugar content increased with number of leaves. Kliewer and Weaver (1971) found a close relationship between leaf area per unit weight of fruit and fruit coloration at harvest. They found that 11-14 cm^2 of leaf surface per gram of fruit was required to produce well colored 'Tokay' fruit. This was equivalent to about 22-26 leaves per cluster. Reddy et al. (1978) reported that in 'Anab-e-Shahi' grapes, the highest TSS (19.9%), highest sugars (15.16%) and sugar acid ratio and minimum acidity were observed when 10 leaves were retained per bunch

providing a leaf area of 1870 cm^2. Purohit et al. (1979) reported that in 'Anab-e-Shahi' grapes, the highest TSS, sugar acid ratio, sugar content and lowest acidity were observed when six leaves were retained per bunch. An IIHR report (Anon., 1985) states that for increased bunch and berry quality in grapes, 2600 cm^2 leaf area is to be retained per bunch in 'Thompson Seedless' and 3000 cm^2 leaf area per bunch in 'Anab-e-Shahi'.

2.4 Effect of leaf pruning on dry matter production and nutrient uptake

Manurial experiments as early as in 1921 had revealed that nitrogen and potassium were required in large amounts by the banana plant (Fawcett, 1921). Baillon et al. (1933) reported that a single banana plant of 'Cavendish' variety in Canary Islands removed approximately 165 g N, 35 g P_2O_5 and 772 g K_2O from the soil. Norris and Ayyar (1942) reported that banana plant required large quantities of potassium, moderate quantities of nitrogen and relatively little phosphorus for optimum production.

Jacob and Uexkull (1960) found that the nutrient removal by a 30 tonne crop was to the tune of 50 to 75 kg N, 15 to 20 kg P_2O_5 and 175 to 220 kg K_2O respectively. Martin-prevel

(1967) estimated the nutrient uptake in 'Dwarf Cavendish' banana as 50 kg M, 12.5 kg P_2O_5 and 150 kg K_2O ha^{-1} for a production of 25 M tonnes ha^{-1} $year^{-1}$. Shanmugham and Velayudhan (1972) estimated the uptake of nutrients by banana plants as 300 kg N, 80 kg P_2O_5 and 800 kg K_2O ha^{-1}. Studies on nutrient uptake by Jauhari et al. (1974) revealed that in the first few months of planting, there was rapid uptake of N, P_2O_5 and K_2O. The content of potassium in leaves and roots decreased with age, but that in rhizome and pseudostem increased. Pseudostem was the richest in potassium. Pillai (1975) found that in banana cv. Poovan, the uptake of N, P and K was comparatively higher in plants with more number of functional leaves which produced well developed bunches than in the plants with lower number of functional leaves. Veeranna et al. (1976) reported that nitrogen and potassium were absorbed more in pre-flowering stage in 'Robusta'. There was however a continuous and steady uptake of nitrogen and potassium and the quantities were almost equal before and after flowering in 'Poovan'. Both 'Poovan' and 'Robusta' produced the same leaf area but differed in the amount of dry matter production.

Sheela and Aravindakshan (1990) stated that in banana cv. Palayankodan, the uptake of nitrogen increased progressively with the growth of plant till shooting time irrespective of the amount of potassium applied but between shooting and harvest, there was a decline. At harvest, a decrease in total uptake was

noticed. They also reported that the total uptake of phosphorus continued to increase throughout the duration of crop. The total uptake of potassium also continued to increase throughout the duration of crop. Among the nutrients, the uptake of potassium was the highest compared to the other two elements.

Kulasekharan (1993) reported that banana requires high amount of mineral nutrients for proper growth and production. From one hectare, by a 50 t banana crop, 320 kg N, 23 kg P_2O_5 and 925 kg $K2_O$ were removed every year. To maintain soil fertility and to permit continuous production, these nutrients must be replenished every year through organic manures and mineral fertilizers. Besides Ca, Mg and other macro and micro nutrients were also essential for satisfactory production.

Similar studies have been conducted in other crops.

Senechal and Gohet (1988) reported that rubber trees artificially defoliated to escape anthracnose disease when subjected to foliar analysis revealed increased K^+ and decreased Ca^{2+} in the tissues. Disease intensity was negatively correlated with K^+ content and positively with Ca^{2+}.

Castagnolis et al. (1989) stated that N remobilisation was substantially decreased by defoliation in plum.

2.5 Effect of leaf pruning on the benefit/cost ratio

Leaf pruning is not recommended as a commercial practice due to bunch mass reduction and the labour cost of pruning. For improved bunch mass and yield per annum, management of the plantation should be good enough to ensure the maximum possible functional leaves on the plant at flowering stage (Anon., 1988).

Thomas et al. (1989) worked out the cost of cultivation for 'Nendran' and 'Robusta' on the assumption that they could be grown at planting densities of 2500 and 2310 plants per hectare respectively. The factors considered were the cost of planting materials, manures, fertilizers, propping materials, labour, income from bunches and suckers and losses due to pests and diseases. They found that 'Robusta' was more profitable than 'Nendran' with benefit/cost ratios 1.34 and 1.28 respectively.

Robinson et al. (1992) reported that no yield benefit was achieved by leaf pruning as a possible management technique in 'Williams' banana. However in the event of frost or hail damage before flower emergence, the results have shown that if an additional eight healthy leaves could emerge before flowering, yield should not be reduced significantly, whereas only four new leaves could result in significant reduction of marketable yield.

Effect of defoliation on benefit/cost ratio of other crops also are reported by research workers.

In coriander cv. PS 360, leaf plucking significantly decreased seed yield but increased the gross returns because of the additional leaf yield (Bhati, 1988).

In West Cost Tall coconut, Sudhakara et al. (1989) reported that the highest income from the sale of leaves was obtained when two leaves were taken every month. Leaf removal had no adverse effect on female flower production, setting percentage or nut yield.

MATERIALS AND METHODS

MATERIALS AND METHODS

The present investigation on 'Regulation of leaf pruning to optimise leaf and bunch harvest in Musa (AB group) Njalipoovan and (AAB group) Palayankodan' was undertaken at the Department of Horticulture, College of Agriculture, Vellayani, Thiruvananthapuram during 1993-94. The location is situated at 8°5' North latitude, 77°1' East latitude and at an altitude of 29 m above the mean sea level. Soil of the experimental site is red loam belonging to Vellayani series.

Sword suckers of uniform size and age were selected and planted in June 1993. The plants were maintained with uniform cultural operations during the cropping period as per the package of practice recommended by the Kerala Agricultural University.

The experimental design adopted was strip plot design. The treatments included three levels of pruning at three intervals as described below:

Pruning levels

L_1 - Removal of 25 per cent of total leaf area.

L_2 - Removal of 50 per cent of total leaf area.

L_3 - Removal of 75 per cent of total leaf area.

(Plate 6)

The leaf area was determined by the equation L x W x 0.8 developed by Murray (1960).

Pruning intervals

I_1 - A day after complete unfurling of the leaves

I_2 - 15 days after complete unfurling of the leaves

I_3 - 30 days after complete unfurling of the leaves

Treatment combinations

Sl. No.	Treatment No.	Leaf area removed (percentage)	Time of removal (days after fully opening)
1	L_0I_0 (control)	(No leaf pruning)	
2	L_1I_1	25	A day after complete unfurling of leaf
3	L_1I_2	25	15 days after complete unfurling of leaf
4	L_1I_3	25	30 days after complete unfurling of leaf
5	L_2I_1	50	A day after complete unfurling of leaf
6	L_2I_2	50	15 days after complete unfurling of leaf
7	L_2I_3	50	30 days after complete unfurling of leaf
8	L_3I_1	75	A day after complete unfurling of leaf
9	L_3I_2	75	15 days after complete unfurling of leaf
10	L_3I_3	75	30 days after complete unfurling of leaf

Thus, for each variety, the total number of treatments came to 9+1 with 3 replications and 4 treatment plants per replication. The treatments were imposed five months after planting during which period the flower bud initiation and differentiation were expected to be completed. Leaves emerged upto 5 months after planting were not pruned in any of the treatments. From fifth month onwards, the date of pruning was fixed based on the date of complete unfurling of the leaves. The pruning interval was fixed based on the assumption that the leaves of these two varieties have a minimum longevity of 50 days under normal management (Turner, 1970 b).

The effect of the treatment on the biometric characters, yield attributes and quality of fruits were observed.

3.1 Vegetative characters

3.1.1 Height of the plant

Height of plant (cm) was recorded from the soil level to the base of the unopened leaf. Observations were recorded at monthly intervals till flowering. From the data, plant height during specific stages of growth were computed.

3.1.2 Girth of the plant

Girth of plant (cm) at monthly intervals was recorded at 10 cm above the ground level till flowering. From the data, plant girth during specific stages of growth were computed.

3.1.3 Number of leaves per plant

Number of leaves per plant at monthly intervals was recorded till flowering. The number of leaves produced during specific growth stages were computed from the data.

3.1.4 Phylachron

Phylachron was recorded by observing the time interval between the opening of 2 successive leaves.

3.1.5 Leaf longevity

Leaf longevity was determined by observing the interval between the date of complete unfurling of the leaf and the date when the lamina is fully yellow.

3.1.6 Functional leaf area

The functional leaf area in both the varieties of banana was calculated using the equation developed by Murray (1960).

LA - L x W x 0.8

LA - leaf area per leaf

L - length of leaf

W - width of leaf

3.1.7 Leaf area index (LAI)

The leaf area index was calculated using the following formula suggested by Watson (1952).

$$LAI = \frac{\text{leaf area per plant}}{\text{area occupied by the plant}}$$

3.1.8 Leaf area duration (LAD)

Leaf area duration was determined using the formula,

$$LAD = \frac{(L_0 + L_1)}{2} X (t_1 - t_0) + \frac{(L_1 + L_2)}{2} X (t_2 - t_1) + \ldots$$

$$\ldots\ldots\ldots + \frac{(Ln_1 + Ln_2)}{2} X (tn_2 - tn_1)$$

where

LAD - leaf area duration, L_0 and L_1 , L_1 and L_2, Ln_1 and Ln_2 are the LAI of the plants at time t_0 and t_1, t_1 and t_2, tn_1 and tn_2 respectively (Power et al., 1967).

3.1.9 Time taken for flowering

Time taken for flowering was recorded from the date of planting to visual bunch emergence and expressed in days.

3.1.10 Time taken for harvest

Time taken for harvest was recorded from the date of visual bunch emergence to date of harvest and was expressed in days.

3.1.11 Number of suckers per plant

Total number of suckers per plant in each treatment was recorded at the time of harvest.

3.1.12 Relative growth rate (RGR)

The relative growth rate was calculated using the formula given by Blackman (1919).

$$RGR = \frac{2.303\ (\log 10 W_2 - \log 10\ W_1)}{t_2 - t_1}$$

RGR - relative growth rate

W1 - height of the plant at time t1

W2 - height of the plant at time t2

3.1.13 Dry weight partitioning between plant parts

One plant from each treatment was uprooted immediately after harvest and separated into corm, suckers, leaves, pseudo stem and leaf sheaths and their weights were recorded. Bunch was separated into fingers and peduncle and their weights were recorded. A sample of 500 grams of different plant parts was dried in hot air oven to calculate the dry matter content. Dry weight of senescent leaves, pruned leaves and pruned suckers collected at different periods were added to the total weight of the plant at harvest. Dry matter production per hectare was calculated by multiplying dry weight of individual plants with the number of plants in one hectare. The plant stand per hectare was calculated based on Kerala Agricultural University recommendations.

3.2 Yield characteristics

Yield characters were recorded soon after harvest.

3.2.1 Bunch weight

3.2.2 Number of hands per bunch

3.2.3 Number of fingers per bunch

3.2.4 Length, girth and weight of fingers

The middle finger in the top row of the second hand (Gottriech et al., 1964) was sampled to record length, girth and weight of fingers.

3.2.5 Peel weight and pulp weight of fruits

The peel and pulp of the fully ripened sample fruits were separately weighed and expressed in gram.

3.2.6 Pulp/peel ratio

Observations under 3.2.5 were used for calculating pulp/peel ratio.

3.3 Quality of fruits

Fully ripe fruits collected from bunches of different treatments were used for quality analysis. The middle fruit in the top row of the second hand was selected as the representative sample (Gottriech et al., 1964). Samples were taken from three portions (top, middle and bottom) from each sample fruit and these samples were then pooled and macerated in a waring blender. Three samples drawn from this were used for analysis of the different quality constitutents of the fruits.

3.3.1 Total soluble solids (TSS)

TSS content of fully ripe fruits was measured directly using Erma refractometer (pocket type) and was expressed as percentage.

3.3.2 Titrable acidity

Titrable acidity was calculated by following the procedure proposed by Ranganna (1977).

A sample of 25 g pulp was made up to 250 ml with distilled water and used for estimation. Results were expressed as percentage anhydrous citric acid.

3.3.3 Total sugars

The total sugars were determined as per the method described by Ranganna (1977). The results were expressed as percentage on fresh weight basis.

3.3.4 Reducing sugars

The reducing sugars of the samples were determined as per the method described by Ranganna (1977) on fresh weight basis.

Samples consisted of 25 g of fresh fruit material made up to 250 ml with distilled water.

3.3.5 Non-reducing sugars

Non-reducing sugar content of the fruit samples were computed as follows using the values obtained for total and reducing sugars.

Non-reducing sugars = Total sugars - Reducing sugars (Ranganna, 1977)

3.3.6 Sugar/acid ratio

Sugar/acid ratio was arrived at by dividing the value for total sugars with the value for titrable acidity of the corresponding sample.

3.3.7 Total carbohydrate

The total carbohydrate content was determined after finding out the starch content as per the method described by A.O.A.C. (1965).

A known weight of the sample was hydrolysed to glucose and estimated by titration with Fehling solution to find out the starch content. The starch content was then added to total sugars to find the total carbohydrate content.

3.3.8. Green Life of fruits

The fruit samples were stored at room temperature in open cardboard boxes in a single row. The number of days taken

from harvest to ripening as indicated by change in fruit colour from green to light yellow was recorded (Stover and Simmonds, 1987).

3.4 Tissue content of major plant nutrients

To assess nutrient content, plant samples were collected at the time of harvest. Sampling was done following the method of Twyford and Walmsley (1973).

The plant parts used for analysis were corm, pseudo stem, leaf sheath, leaf and bunch. The samples were analysed for nitrogen, phosphorus and potassium content. Results were expressed as gram plant^{-1} on dry weight basis.

3.5 Economics of cultivation

Benefit/cost ratio of various treatments were worked out, considering all aspects of cost of cultivation and the income derived from the plant. It was calculated as per the norms and rates fixed by the Instructional Farm, College of Agriculture, Vellayani.

3.6 Statistical analysis

The data collected on different characteristics were analysed by applying the technique of analysis of variance for strip plot design following Panse and Sukhatme (1967).

RESULTS

RESULTS

The present investigations were carried out to study the effect of different levels of leaf pruning on the growth, yield and quality of banana cvs. Njalipoovan and Palayankodan so as to determine the optimum leaf area for maximum yield and fruit quality. The experiment was conducted at the Department of Horticulture, College of Agriculture, Vellayani, Thiruvananthapuram from June 1993 to August 1994. The results of the study are presented below:

4.1 Effect of leaf pruning on the vegetative characters of banana cvs. Njalipoovan and Palayankodan.

4.1.1 Effect of leaf pruning on the height of banana cvs. Njalipoovan and Palayankodan.

The results of the study on the effect of leaf pruning on plant height of banana cvs. Njalipoovan and Palayankodan are presented in Table 1, Fig. 1 and Fig. 2.

The data on the combined effect of leaf area removed and the interval of pruning indicated that in 'Njalipoovan', there was no significant difference in plant height between treatments during the third, fifth or seventh month after planting or at bunch emergence stage. Similar results were obtained in case of 'Palayankodan' also.

Table 1 Effect of leaf pruning on the height of banana cvs. Njalipoovan and Palayankodan

Treatment	Njalipoovan				Palayankodan			
	Height of plants (cm)				Height of plants (cm)			
	Stages after planting				Stages after planting			
	3 months	5 months	7 months	At bunch emergence	3 months	5 months	7 months	At bunch emergence
L_0I_0	68.43	154.50	232.93	279.50	78.67	165.77	238.70	276.67
L_1I_1	66.17	150.07	210.77	274.87	79.70	164.06	216.40	255.63
L_1I_2	70.60	151.53	224.33	274.33	82.63	159.50	230.63	265.33
L_1I_3	75.27	151.87	232.77	281.50	79.26	157.96	237.57	269.30
L_2I_1	75.30	149.13	204.10	265.83	79.70	162.37	210.07	244.53
L_2I_2	71.97	149.07	213.90	270.73	80.27	163.93	222.67	257.46
L_2I_3	76.43	145.03	225.50	275.50	76.03	163.60	236.60	267.87
L_3I_1	72.53	152.20	200.77	264.37	79.40	164.50	210.00	240.47
L_3I_2	74.70	149.13	206.90	268.70	77.30	163.67	213.00	250.36
L_3I_3	73.03	146.97	217.07	276.13	73.87	162.00	232.53	259.60
F-test	NS	NS	NS	NS	NS	NS	NS	NS
SE	3.72	4.25	5.34	7.20	5.10	4.03	4.88	3.96
CD(0.05)	-	-	-	-	-	-	-	-
L_1	70.68	151.16	222.62	276.90	80.53	160.71	228.20	263.42
L_2	74.57	147.74	214.50	270.69	78.67	163.30	223.11	256.62
L_3	73.42	149.43	208.24	269.73	76.86	163.39	218.60	250.14
F-test	NS	NS	*	NS	NS	*	**	*
SE	3.05	2.20	2.87	2.80	2.91	0.73	1.25	2.98
CD(0.05)	-	-	7.980	-	-	2.023	3.478	8.260
I_1	71.33	150.46	205.21	268.36	79.60	163.84	212.16	246.88
I_2	72.42	149.91	215.04	271.26	80.07	162.37	222.19	257.72
I_3	74.91	147.96	225.11	277.71	76.39	161.19	235.57	265.59
F-test	NS	NS	*	NS	NS	NS	**	*
SE	1.24	2.61	4.46	3.75	1.52	3.98	2.03	3.92
CD(0.05)	-	-	12.38	-	-	-	5.643	10.880

NS - Not significant
* - Significant at 5% level
** - Significant at 1% level

The individual effect of leaf area removed did not significantly influence the height of plants in 'Njalipoovan' during the third or fifth month after planting or at the bunch emergence stage. However significant difference was observed among the height of plants during the seventh month after planting. At this stage, the plant height was the highest (222.62 cm) in L_1 where 25 per cent of the leaf lamina was removed. This was followed by L_2 (214.50 cm) wherein 50 per cent of the leaf area was removed and L_3 (208.24 cm) wherein 75 per cent of the lamina was removed. The treatments L_2 and L_1 were statistically on par. In 'Palayankodan' significant difference in plant height was observed during the fifth month after planting. At this stage, the plant height was the highest in L_3 (163.39 cm). This was followed by L_2 (163.30 cm) and L_1 (160.71 cm). The treatments L_2 and L_3 were statistically on par and significantly superior to L_1. During the seventh month after planting also, significant difference was observed in the height of plants in the different treatments. Highest value for plant height was in L_1 (228.20 cm). This was followed by L_2 (223.11 cm) and L_3 (218.60 cm). The three treatments were significantly different from one another. At bunch emergence stage also, the extent of leaf area removed significantly affected plant height. Highest value for plant height was in L_1 (263.42 cm) followed by L_2 (256.62 cm); the two treatments being statistically on par. The lowest plant height was recorded in L_3 (250.14 cm).

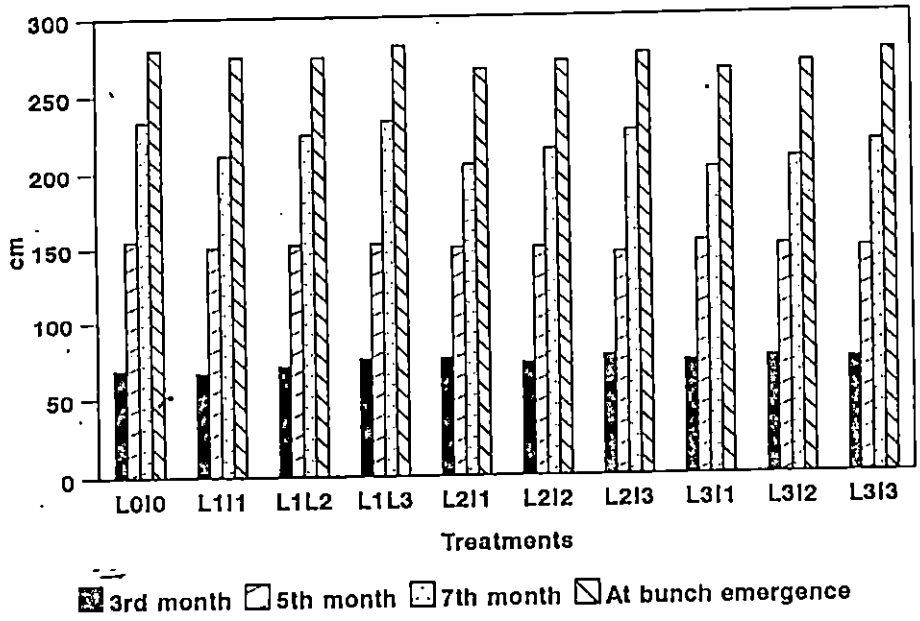


Fig. 1. Effect of leaf pruning on the plant height of banana cv. Njalipoovan

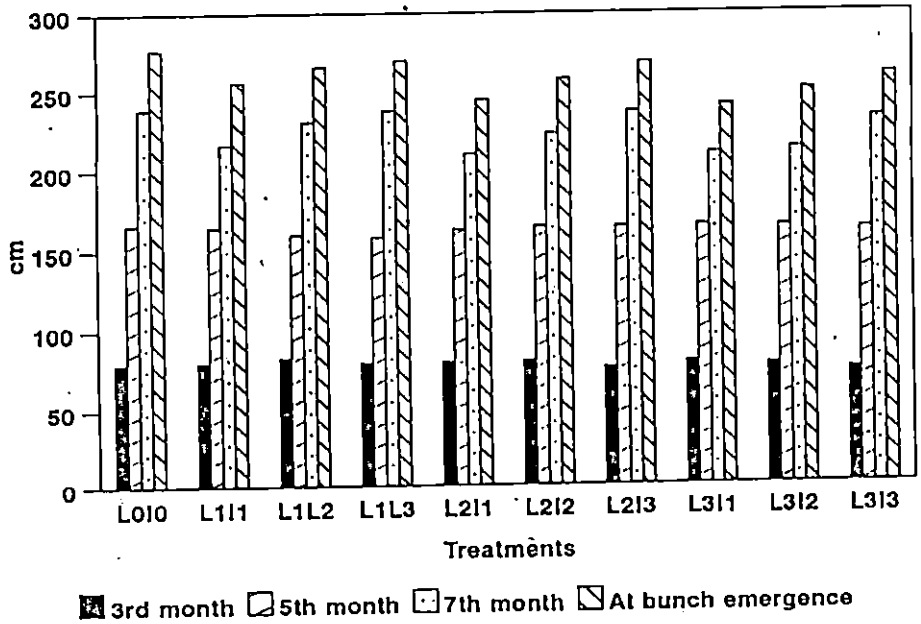


Fig. 2. Effect of leaf pruning on the plant height of banana cv. Palayankodan

effect of these treatments individually had a more prounced effect on plant height in both the varieties studied. It was observed that removal of 25 to 50 per cent of the leaf area after 15-30 days of unfurling had less deleterious effect on the plant height. It was also observed that 'Njalipoovan' was comparatively less affected by this leaf pruning strategy compared to 'Palayankodan'.

4.1.2 Effect of leaf pruning on the girth of banana cvs. Njalipoovan and Palayankodan

Results of the study are presented in Table 2.

The data revealed that the girth of plants was not significantly affected by the combined effect of leaf area removed and the time of pruning in both cultivars.

The extent of leaf area removed affected the girth of 'Njalipoovan' plants at bunch emergence. At this stage, highest plant girth was observed in L_1 (52.40 cm) followed by L_2 (49.83 cm) and L_3 (48.36 cm). The treatment L_1 was significantly superior to L_2 and L_3; the latter two being statistically on par. In 'Palayankodan' however, the area of lamina pruned did not significantly affect the girth of plants at any of the stages observed.

Table 2 Effect of leaf pruning on the girth of banana cvs. Njalipoovan and Palayankodan

Treatment	Njalipoovan				Palayankodan			
	Girth of plants (cm)				Girth of plants (cm)			
	Stages after planting				Stages after planting			
	3 months	5 months	7 months	At bunch emergence	3 months	5 months	7 months	At bunch emergence
L_0I_0	21.83	39.63	45.80	53.90	32.33	40.43	54.30	63.40
L_1I_1	20.43	40.27	45.63	52.17	38.76	45.20	50.77	59.47
L_1I_2	21.50	40.87	43.57	49.57	35.50	40.63	54.43	64.67
L_1I_3	19.13	40.27	45.20	55.46	37.87	42.26	53.10	62.03
L_2I_1	21.22	40.10	42.30	46.46	33.80	42.10	49.17	57.27
L_2I_2	21.53	41.00	44.00	49.43	33.80	49.40	49.50	59.70
L_2I_3	19.74	39.97	44.13	53.60	33.73	40.97	50.40	58.67
L_3I_1	18.83	38.17	40.63	45.30	36.10	41.90	49.67	55.33
L_3I_2	20.60	40.13	43.97	48.77	33.60	40.80	50.60	58.23
L_3I_3	21.80	39.76	45.60	51.00	34.30	43.13	50.70	60.67
F-test	NS	NS	NS	NS	NS	NS	NS	NS
SE	1.67	1.48	2.23	2.62	3.14	2.09	1.97	2.47
CD(0.05)	-	-	-	-	-	-	-	-
L_1	20.36	40.46	44.80	52.40	37.38	42.70	52.77	62.06
L_2	20.83	40.36	43.48	49.83	33.78	40.82	49.69	58.54
L_3	20.42	39.36	43.40	48.36	34.67	41.94	50.32	58.08
F-test	NS	NS	NS	*	NS	NS	NS	NS
SE	0.98	1.51	0.75	0.75	4.32	2.13	1.66	1.66
CD(0.05)	-	-	-	2.078	-	-	-	-
I_1	20.17	39.51	42.85	49.98	36.22	43.07	49.87	57.36
I_2	21.22	40.67	43.85	49.26	34.30	40.28	51.51	60.87
I_3	20.22	40.00	44.98	53.36	35.30	42.12	51.40	60.46
F-test	NS	NS	NS	NS	NS	NS	NS	NS
SE	0.67	1.24	2.27	1.73	1.79	1.94	1.79	2.99
CD(0.05)	-	-	-	-	-	-	-	-

NS - Not significant
* - Significant at 5% level

The time of leaf pruning had no significant bearing on the plant girth in both the cultivars.

The studies thus indicated that, in general, the girth of 'Njalipoovan' and 'Palayankodan' was not severely affected by the leaf pruning treatments imposed.

4.1.3 Effect of leaf pruning on the total number of leaves produced in banana cvs. Njalipoovan and Palayankodan

The results of the study on the effect of leaf pruning on the leaf production of banana cvs. Njalipoovan and Palayankodan are presented in Table 3.

The data revealed that the leaf production of the control plants did not differ significantly from that of the treated plants. The combined effect of the area of leaf removed by way of pruning and the time of pruning did not adversely affect the number of leaves produced in both 'Njalipoovan' and 'Palayankodan'.

The effect of the extent of leaf area removed did not significantly affect the leaf production in 'Palayankodan' or 'Njalipoovan'. Similarly, the time of removal of leaf also did not significantly affect the leaf production in both the varieties. It is therefore presumed that leaf pruning treatments imposed in the present study did not adversely affect the number of leaves produced in 'Palayankodan' and 'Njalipoovan'.

Table 3 Effect of leaf pruning on the total number of leaves produced in banana cvs. Njalipoovan and Palayankodan

Treatment	Njalipoovan				Palayankodan			
	Total number of leaves produced				Total no. of leaves produced			
	Stages after planting				Stages after planting			
	3 months	5 months	7 months	At bunch emergence	3 months	5 months	7 months	At bunch emergence
L_0I_0	11.08	19.50	32.17	41.83	8.17	14.33	22.33	29.65
L_1I_1	10.83	20.00	33.17	40.67	8.00	14.66	21.92	32.60
L_1I_2	11.00	20.18	33.58	41.83	9.08	13.83	22.33	31.82
L_1I_3	11.00	18.42	32.00	40.58	7.50	14.00	22.67	27.86
L_2I_1	11.00	18.42	33.25	41.25	8.00	14.00	22.58	31.45
L_2I_2	11.50	20.66	32.33	41.33	8.50	13.66	23.00	29.12
L_2I_3	10.75	19.52	33.25	40.17	8.00	13.83	22.33	31.02
L_3I_1	11.25	19.34	32.25	40.50	8.00	12.58	22.00	29.18
L_3I_2	10.91	20.59	31.97	41.17	7.50	14.50	21.83	32.00
L_3I_3	11.25	20.17	33.08	41.00	9.08	14.75	23.00	32.00
F-test	NS	NS	NS	NS	NS	NS	NS	NS
SE	0.27	0.27	0.30	0.37	0.20	0.21	0.20	0.22
CD(0.05)	-	-	-	-	-	-	-	-
L_1	10.94	19.53	32.92	41.36	8.19	14.16	22.31	30.76
L_2	11.08	19.53	32.94	40.92	8.17	13.83	22.64	30.53
L_3	11.14	20.03	32.43	40.89	8.19	13.94	22.28	31.06
F-test	NS	NS	NS	NS	NS	NS	NS	NS
SE	0.23	0.16	0.15	0.12	0.08	0.12	0.13	0.15
CD(0.05)	-	-	-	-	-	-	-	-
I_1	11.03	19.25	32.89	40.81	8.00	13.75	22.17	31.08
I_2	11.14	20.48	32.63	41.44	8.36	14.00	22.39	30.98
I_3	11.00	19.37	32.78	40.92	8.19	14.19	22.67	30.29
F-test	NS	NS	NS	NS	NS	NS	NS	NS
SE	0.08	0.38	0.25	0.19	0.11	0.15	0.16	0.18
CD(0.05)	-	-	-	-	-	-	-	-

NS - Not significant

4.1.4 Effect of leaf pruning on the phylachron of banana cvs. Njalipoovan and Palayankodan

The results of the study on the effect of leaf pruning on the phylachron of banana cvs. Njalipoovan and Palayankodan are presented in Table 4.

The study revealed that the phylachron of control plants was not significantly different from that of the treated plants. The combined effect of the extent of leaf area removed and the time of pruning did not have a significant effect on the phylachron (the time interval between the production of two successive leaves) in either 'Njalipoovan' or 'Palayankodan'.

The data on the effect of the area of lamina removed also showed that there was no significant difference between treatments in the phylachron of either 'Njalipoovan' or 'Palayankodan'.

The time of pruning of leaves also did not adversely affect the phylachron in both 'Njalipoovan' and 'Palayankodan' since there was no significant difference between treatments with respect to the time when the leaves were pruned in both the varieties.

4.1.5 Effect of leaf pruning on the leaf longevity of banana cvs. Njalipoovan and Palayankodan.

The results of the study on the effect of leaf pruning on the leaf longevity of banana cvs. Njalipoovan and Palayankodan are presented in Table 5.

The data on the combined effect of leaf area removed and the time of pruning indicated that in 'Njalipoovan', there was no significant difference in leaf longevity in the different treatments upto bunch emergence stage. Also, the mean longevity of the control plants was not significantly different from the mean value of leaf longevity of the treated plants upto this stage. Similar results were obtained with respect to the leaf longevity of 'Palayankodan' also. At harvest stage, the interaction effect of the different treatments significantly influenced the leaf longevity in 'Njalipoovan' though not in 'Palayankodan'. In 'Njalipoovan' at harvest stage, the control plants recorded the lowest leaf longevity ((109.17 days). This was significantly lower than the mean value of leaf longevity of the treated plants. The highest leaf longevity at this stage was observed in L_3I_1 (122.42 days) followed by L_1I_2 (121.75 days), L_2I_3 (119.32 days), L_3I_2 (118.67 days) and L_2I_1 (118.33 days) and these treatments were statistically on par. The lowest longevity of leaves was observed in L_0I_0 (109.17 days) followed by L_1I_3 (110.66 days), the two treatments being statistically on

Table 5 Effect of leaf pruning on the leaf longevity of banana cvs. Njalipoovan and Palayankodan

Treatment	Njalipoovan					Palayankodan				
	Leaf longevity (days)					Leaf longevity (days)				
	Stages after planting					Stages after planting				
	3 months	5 months	7 months	At bunch emergence	At harvest	3 months	5 months	7 months	At bunch emergence	At harvest
L_0I_0	55.33	63.83	72.08	80.00	109.17	59.33	63.75	81.83	98.17	122.50
L_1I_1	54.92	58.66	72.33	86.00	115.58	59.42	64.08	79.92	101.42	124.08
L_1I_2	58.00	60.83	71.58	83.83	121.75	61.17	64.83	81.25	99.92	121.58
L_1I_3	57.00	60.32	70.83	80.82	110.66	61.08	63.33	84.92	98.17	122.67
L_2I_1	54.66	61.00	74.33	87.67	118.33	59.75	64.17	82.42	105.17	126.25
L_2I_2	55.83	60.75	73.17	84.00	114.58	60.67	61.91	82.50	97.33	124.75
L_2I_3	57.25	60.00	72.67	80.67	119.32	61.00	64.16	82.50	98.75	124.58
L_3I_1	56.08	62.83	74.50	97.17	122.42	60.33	64.91	84.33	110.83	130.08
L_3I_2	55.33	61.17	75.17	90.67	118.67	61.34	63.00	80.17	107.00	126.42
L_3I_3	54.17	60.42	70.17	90.33	116.17	61.00	62.33	81.83	100.58	125.83
F-test	NS	NS	NS	NS	**	NS	NS	NS	NS	NS
SE	1.02	1.35	-	3.12	1.92	0.72	1.19	-	2.49	1.79
CD(0.05)	-	-	-	-	5.330	-	-	-	-	-
L_1	56.64	59.94	71.58	83.56	116.00	60.56	64.08	82.03	99.83	122.78
L_2	55.92	60.58	73.39	84.11	117.42	60.47	63.42	82.47	100.42	125.19
L_3	55.19	61.47	73.29	92.72	119.08	60.89	63.42	82.11	106.14	127.44
F-test	NS	NS	NS	**	NS	NS	NS	NS	*	*
SE	1.30	0.50	-	1.43	2.38	0.93	0.38	-	1.26	0.92
CD(0.05)	-	-	-	3.976	-	-	-	-	3.493	3.628
I_1	55.22	60.83	73.72	90.28	118.78	59.83	64.39	82.22	105.81	126.81
I_2	56.38	60.92	73.31	86.17	118.33	61.06	63.25	81.31	101.42	124.25
I_3	56.14	60.25	71.22	83.94	115.39	61.03	63.28	83.08	99.17	124.36
F-test	NS	NS	*	**	NS	NS	NS	NS	NS	NS
SE	1.40	0.46	-	1.05	1.98	0.39	0.69	-	2.12	1.31
CD(0.05)	-	-	1.876	2.910	-	-	-	-	-	-

NS - Not significant
* - Significant at 5% level
** - Significant at 1% level

par. However L_1I_3 was statistically on par with L_2I_2 (114.58 days) and L_1I_1 (115.58 days).

The extent of leaf area removed significantly influenced the leaf longevity of 'Njalipoovan' at bunch emergence stage, but not at harvest stage. At bunch emergence stage, leaf longevity was the highest in L_3 (92.72 days) followed by L_2 (84.11 days) and L_1 (83.56 days). The treatment L_3 was significantly superior to L_2 and L_1; the latter two being statistically on par. In 'Palayankodan' there was significant difference in the leaf longevity during bunch emergence stage. L_3 recorded the highest value for leaf longevity (106.14 days) followed by L_2 (100.42 days) and L_1 (99.83 days). The treatment L_3 was significantly superior to L_2 and L_1; the latter two being statistically on par. At harvest stage, L_3 recorded the highest leaf longevity (127.44 days) followed by L_2 (125.19 days) and these treatments were statistically on par. The lowest leaf longevity value was recorded in L_1 (122.78 days) which was statistically on par with L_2.

The time of leaf pruning had a significant influence on leaf longevity of 'Njalipoovan' during the seventh month after planting. The highest leaf longevity value was observed in I_1 (73.72 days) followed by I_2 (73.31 days); the two treatments being statistically on par. The lowest value for leaf longevity

was recorded in I_3 (71.22 days). At bunch emergence stage, the treatment I_1 recorded the highest leaf longevity (90.28 days) followed by I_2 (86.17 days) and I_3 (83.94 days). The treatment I_1 was significantly superior to I_2 and I_3; the latter two being statistically on par. However in 'Palayankodan', the time of pruning did not affect the longevity of leaves at any of the stages of study.

The results of the study thus indicated that leaf pruning in general increased the longevity of the intact portion of leaf on the plant. The severest pruning treatment resulted in the longest life and vice versa. The extent of lamina removed had a more pronounced effect on the longevity of leaf than the time of pruning in 'Palayankodan'. Removal of more than 50 per cent of lamina increased the leaf longevity in 'Njalipoovan' as well as in 'Palayankodan'.

The results are also indicative of the varietal differences in response to leaf pruning. It was observed that 'Njalipoovan' responded more to leaf pruning than 'Palayankodan' in relation to extension of leaf life.

4.1.6 Effect of leaf pruning on the functional leaf area of banana cvs. Njalipoovan and Palayankodan

The results of the study are presented in Table 6, Fig. 3 and Fig. 4.

Table 6 Effect of leaf pruning on the functional leaf area of banana cvs. Njalipoovan and Palayankodan

Treatment	Njalipoovan					Palayankodan				
	Functional leaf area (m^2 $plant^{-1}$)					Functional leaf area (m^2 $plant^{-1}$)				
	Stages after planting					Stages after planting				
	3 months	5 months	7 months	At bunch emergence	At harvest	3 months	5 months	7 months	At bunch emergence	At harvest
L_0I_0	2.15	3.38	5.57	8.86	3.17	1.97	3.28	5.85	8.97	4.30
L_1I_1	2.10	3.20	4.52	5.84	1.09	1.85	3.04	4.83	6.59	2.93
L_1I_2	2.12	3.26	4.71	5.95	1.62	1.96	3.22	5.08	6.87	2.94
L_1I_3	2.04	3.27	5.15	6.24	3.01	1.95	3.08	5.37	7.29	2.58
L_2I_1	2.14	3.43	4.04	4.07	1.52	1.99	3.16	4.21	4.11	1.74
L_2I_2	2.18	3.59	4.24	4.28	1.49	1.89	3.47	4.79	5.17	2.02
L_2I_3	2.13	3.36	4.51	4.90	1.76	1.98	3.12	5.10	5.75	2.29
L_3I_1	2.13	3.57	3.58	2.64	1.03	1.93	3.11	3.72	3.18	1.13
L_3I_2	2.10	3.45	3.84	3.47	0.99	1.97	3.30	4.51	4.03	1.39
L_3I_3	2.09	3.20	4.02	4.06	1.04	1.96	3.60	4.75	4.26	1.06
F-test	NS	NS	NS	NS	**	NS	NS	NS	*	NS
SE	0.17	0.24	0.18	0.21	0.19	0.06	0.17	0.18	0.14	0.26
CD(0.05)	-	-	-	-	0.525	-	-	-	0.389	-
L_1	2.09	3.25	4.80	6.01	1.91	1.92	3.11	5.09	6.92	2.81
L_2	2.15	3.47	4.27	4.42	1.59	1.96	3.25	4.70	5.01	2.02
L_3	2.10	3.41	3.81	3.39	1.02	1.96	3.34	4.33	3.82	1.19
F-test	NS	NS	**	**	**	NS	NS	*	**	**
SE	0.10	0.14	0.15	0.09	0.09	3.03	0.11	0.10	0.11	0.16
CD(0.05)	-	-	0.411	0.259	0.183	-	-	0.394	0.318	0.456
I_1	2.12	3.40	4.05	4.22	1.22	1.92	3.11	4.25	4.63	1.93
I_2	2.13	3.44	4.27	4.53	1.37	1.94	3.33	4.79	5.35	2.11
I_3	2.09	3.28	4.56	5.07	1.94	1.97	3.26	5.08	5.76	1.98
F-test	NS	NS	**	*	NS	NS	NS	**	**	NS
SE	0.20	0.09	0.07	0.22	0.22	0.04	0.13	0.13	0.13	0.26
CD(0.05)	-	-	0.196	0.603	-	-	-	0.301	0.350	-

NS - Not significant
* - Significant at 5% level
** - Significant at 1% level

The data revealed that the combined effect of area of lamina removed and the time of pruning had significant influence on the functional leaf area in 'Njalipoovan' at harvest stage but not in other stages observed. At harvest stage, the highest leaf area was recorded in L_0I_0 (3.17 m^2) and this was significantly higher than that of the treated plants. This was followed by L_1I_3 (3.01 m^2); the two treatments being significantly superior to the other treatments. The treatment L_2I_3 (1.76 m^2) which followed L_1I_3 was statistically on par with L_1I_2 (1.62 m^2), L_2I_1 (1.52m^2) and L_2I_2 (1.49m^2). The lowest functional leaf area was recorded in L_3I_2 (0.99 m^2) which was statistically on par with L_3I_1 (1.03 m^2), L_3I_2 (1.04 m^2), L_1I_1 (1.09 m^2) and L_2I_2 (1.49 m^2).

The combined effect of leaf area removed and the time of pruning had significant efect on the functional leaf area of 'Palayankodan' at bunch emergence stage but not in other stages observed. The highest functional leaf area at bunch emergence stage in 'Palayankodan' was recorded in L_0I_0 (8.97 m^2) which was significantly superior to all the other treatments. This was followed by L_1I_3 (7.29 m^2) which was superior to all other treatments except L_0I_0. The treatments L_1I_2 (6.87 m^2) and L_1I_1 (6.59 m^2) followed L_1I_3 and the former two were statistically on par. The lowest functional leaf area was observed in L_3I_1 (3.18 m^2) which was significantly lower than all the other treatments.

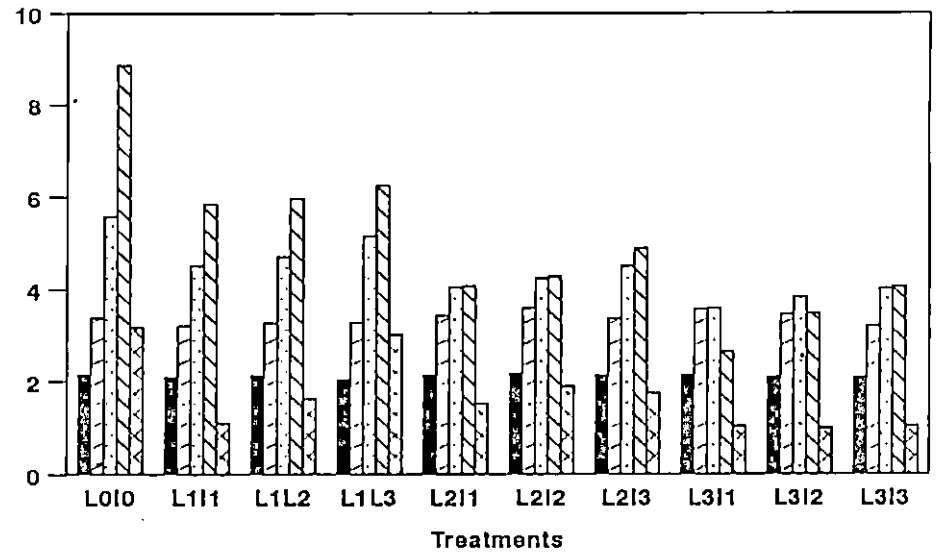


Fig. 3. Effect of leaf pruning on the functional leaf area of banana cv. Njalipoovan

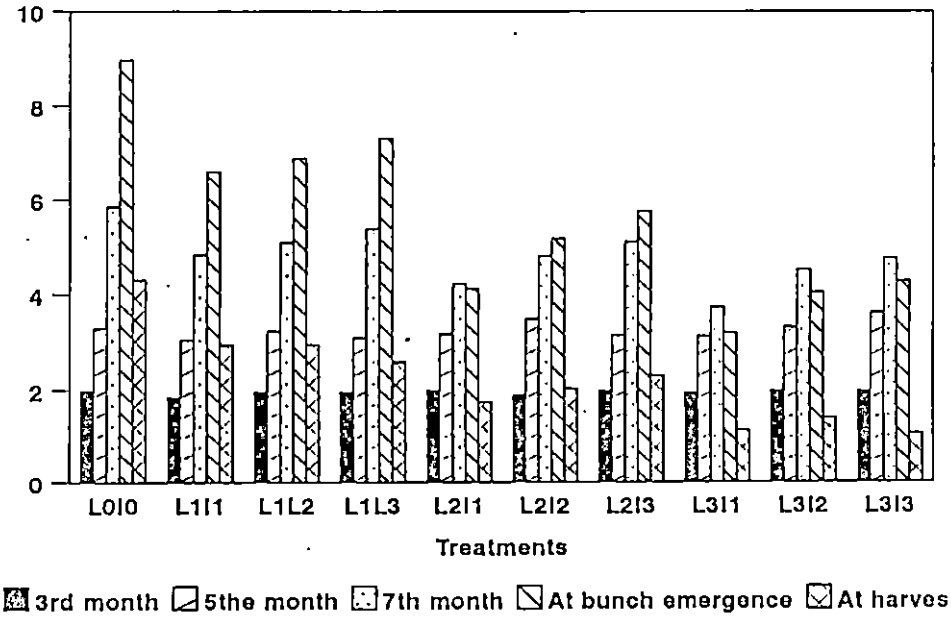


Fig. 4. Effect of leaf pruning on the functional leaf area of banana cv. Palayankodan

The treatments L_3I_2 (4.03 m^2), L_2I_1 (4.11 m^2) and L_3I_3 (4.26 m^2) which showed lesser functional leaf area following L_3I_1 were statistically on par.

The extent of leaf area removed had a significant influence on the functional leaf area of both 'Njalipoovan' and 'Palayankodan' during the seventh month after planting, at bunch emergence stage and at harvest stage. In 'Njalipoovan' during the seventh month after planting the functional leaf area was the highest in L_1 (4.80 m^2) followed by L_2 (4.27 m^2) and L_3 (3.81 m^2). The three treatments were significantly different from one another. At bunch emergence stage, the functional leaf area was the highest in L_1 (6.01 m^2) followed by L_2 (4.42 m^2) and L_3 (3.39 m^2). The three treatments were significantly different from one another. At harvest stage, the highest functional leaf area was recorded in L_1 (1.91 m^2) which was significantly superior to L_2 (1.59 m^2). The lowest functional leaf area was recorded in L_3 (1.02 m^2) which was significantly lower than L_2.

In 'Palayankodan' during the seventh month after planting, the functional leaf area was the highest in L_1 (5.09 m^2) followed by L_2 (4.70 m^2); the two treatments being statistically on par. The lowest functional leaf area was recorded in L_3 (4.33 m^2). The treatments L_3 and L_2 were statistically on par. At bunch emergence stage, the highest functional leaf area was recorded in L_1 (6.92 m^2) which was

significantly superior to L_2 (5.01 m^2). The lowest functional leaf area recorded in L_3 (3.82 m^2) was significantly lower than L_2. At harvest stage also, the treatment L_1 (2.81 m^2) had a significantly higher functional leaf area compared to L_2 (2.02 m^2) which followed the former. The functional leaf area in L_3 (1.19 m^2) was significantly lower to that of L_2.

The time of pruning had significant effect on the functional leaf area during the seventh month after planting and at bunch emergence stage in 'Njalipoovan'. The highest functional leaf area during the seventh month after planting was recorded in I_3 (4.56 m^2) followed by I_2 (4.27 m^2) and I_1 (4.05 m^2). The three treatment effects were significantly different from one another. At bunch emergence stage, the highest functional leaf area was recorded in I_3 (5.07 m^2) followed by I_2 (4.53 m^2) and I_1 (4.22 m^2). The treatments I_1 and I_2 were statistically on par and so were I_2 and I_3. At harvest stage, the treatment effects were not significantly different.

In 'Palayankodan' also, there was significant difference in the functional leaf area during the seventh month after planting and at the bunch emergence stage due to the time of leaf pruning. During the seventh month after planting, the treatment I_3 recorded the highest functional leaf area (5.08 m^2) followed by I_2 (4.79 m^2); the two treatments being statistically

on par. The lowest functional leaf area was recorded in I_1 (4.25 m^2). The treatment I_1 was significantly lower than the other treatments. At bunch emergence stage, the treatment I_3 recorded the highest functional leaf area (5.76 m^2) followed by I_2 (5.35 m^2) and I_1 (4.63 m^2). The three treatments differed significantly from one another. There was no significant difference between the treatments at harvest stage.

In general it could be inferred that the functional leaf area decreased significantly with increase in severity of leaf pruning in both the cultivars. Both the leaf area removed by way of pruning and the time of pruning had effect on the functional leaf area. In general, the removal of more than 50 per cent of the lamina prior to 15 days after unfurling had deleterious effect on the functional leaf area. But removal of 25 to 50 per cent of the leaf lamina after 15 to 30 days of unfurling had less deleterious effect on the functional leaf area of both 'Njalipoovan' and 'Palayankodan'.

4.1.7 Effect of leaf pruning on the leaf area index and leaf area duration of banana cvs. Njalipoovan and Palayankodan

Results of the study are presented in Table 7.

The data on the combined effect of extent of leaf area removed and the time of pruning indicated that there was

Table 7 Effect of leaf pruning on the leaf area index (LAI) and leaf area duration (LAD) of banana cvs. Njalipoovan and Palayankodan

Treatment	Njalipoovan						Palayankodan					
	Leaf area index (LAI)						Leaf area index (LAI)					
	Stages after planting						Stages after planting					
	3 months	5 months	7 months	At bunch emergence	At harvest	LAD	3 months	5 months	7 months	At bunch emergence	At harvest	LAD
L_0I_0	0.477	0.747	1.228	1.952	0.697	412.62	0.437	0.723	1.289	1.977	1.166	433.36
L_1I_1	0.467	0.707	0.997	1.310	0.243	306.47	0.407	0.673	1.064	1.453	0.647	348.27
L_1I_2	0.470	0.720	1.107	1.280	0.356	320.85	0.430	0.710	1.120	1.512	0.647	368.41
L_1I_3	0.460	0.733	1.068	1.373	0.657	355.36	0.430	0.676	1.184	1.606	0.567	403.85
L_2I_1	0.470	0.757	0.891	0.897	0.337	267.08	0.440	0.697	0.928	0.906	0.383	298.07
L_2I_2	0.480	0.793	0.935	0.946	0.330	287.83	0.420	0.766	1.055	1.140	0.447	337.78
L_2I_3	0.466	0.740	0.995	1.073	0.386	305.16	0.436	0.686	1.125	1.267	0.507	337.31
L_3I_1	0.470	0.787	0.790	0.580	0.226	236.36	0.427	0.683	0.819	0.700	0.250	251.61
L_3I_2	0.463	0.763	0.883	0.763	0.218	250.55	0.437	0.727	0.995	0.887	0.307	272.70
L_3I_3	0.463	0.703	0.886	0.897	0.233	262.69	0.790	0.790	1.040	0.937	0.226	290.23
F-test	NS	NS	NS	NS	**	NS	NS	NS	NS	*	NS	NS
SE	0.038	0.055	0.038	0.046	0.04	9.012	0.011	0.037	0.035	0.031	0.055	7.421
CD(0.05)	-	-	-	-	0.118	-	-	-	-	0.086	-	-
L_1	0.466	0.720	1.057	1.323	0.419	327.56	0.422	0.687	1.123	1.524	0.620	373.51
L_2	0.472	0.763	0.940	0.972	0.351	286.69	0.432	0.717	1.036	1.104	0.446	324.39
L_3	0.466	0.751	0.853	0.747	0.220	249.86	0.433	0.733	0.950	0.841	0.261	271.52
F-test	NS	NS	*	**	**	**	NS	NS	*	**	**	**
SE	0.025	0.034	0.030	0.020	0.01	5.772	0.005	0.020	0.023	0.025	0.036	5.360
CD(0.05)	-	-	0.082	0.057	0.041	16.02	-	-	0.089	0.071	0.100	14.88
I_1	0.469	0.750	0.893	0.929	0.269	269.97	0.424	0.684	0.937	1.020	0.427	299.32
I_2	0.471	0.759	0.975	0.999	0.296	286.41	0.429	0.734	1.057	1.180	0.467	326.30
I_3	0.463	0.726	0.983	1.114	0.426	307.74	0.434	0.718	1.116	1.270	0.433	343.79
F-test	NS	NS	NS	*	NS	**	NS	NS	**	**	NS	**
SE	0.046	0.018	0.027	0.047	0.05	2.027	0.010	0.027	0.032	0.028	0.055	3.995
CD(0.05)	-	-	-	0.132	-	5.629	-	-	0.065	0.077	-	11.09

LAI - Leaf area index LAD - Leaf area duration NS - Not significant
* - Significant at 5% level ** - Significant at 1% level

significant difference between treatments with regard to leaf area index in 'Njalipoovan' at harvest stage, but not in other stages observed. At harvest stage, leaf area index was the highest in L_0I_0 (0.697) and this was significantly superior to the mean value of leaf area index of the treated plants. L_0I_0 was followed by L_1I_3 (0.657). These two treatments were statistically on par and significantly superior to all the other treatments. The treatments L_2I_3 (0.386), L_1I_2 (0.356), L_2I_1 (0.33) and L_2I_2 (0.330) which followed L_1I_3 were statistically on par. The lowest leaf area index value was recorded in L_3I_2 (0.218) followed by L_3I_1 (0.226), L_3I_3 (0.233), L_1I_1 (0.243) and L_2I_2 (0.330); all these treatments being statistically on par.

There was no significant difference between treatments in the leaf area index of 'Palayankodan' except at bunch emergence stage. The highest value at this stage was recorded in L_0I_0 (1.977) which was significantly superior to the mean value of leaf area index of all the other treatments. This was followed by L_1I_3 (1.606) which was superior to all other treatments except L_0I_0. The treatments L_1I_2 (1.512) and L_1I_1 (1.453) which followed L_1I_3 were statistically on par. The lowest leaf area index values were recorded in L_3I_1 (0.700) which differed significantly from the other treatments. The treatment L_3I_2 (0.887), L_2I_1 (0.906) and L_3I_3 (0.937) which followed L_3I_1 were statistically on par.

The individual effect of leaf area removed on the leaf area index was significant between treatments in 'Njalipoovan' during the seventh month after planting, at bunch emergence stage and at the harvest stage. During the seventh month after planting, the highest leaf area index was recorded in L_1 (1.057) followed by L_2 (0.940) and L_3 (0.853). The three treatments differed significantly from one another. At bunch emergence stage, the highest leaf area index was recorded in L_1 (1.323) followed by L_2 (0.972) and L_3 (0.747). All the treatments significantly differed from one another. The same trend was observed at the harvest stage also. L_1 recorded the highest leaf area index (0.419) followed by L_2 (0.351) and L_3 (0.220); all the treatments differing significantly from one another.

The extent of leaf area removed significantly affected the leaf area index in 'Palayankodan' also. During the seventh month after planting the highest leaf area index was recorded in L_1 (1.123) followed by L_2 (1.036); the two treatments being statistically on par. L_3 (0.950) recorded the lowest leaf area index. The treatments L_2 and L_3 were statistically on par. At bunch emergence stage, L_1 (1.524) recorded the highest leaf area index followed by L_2 (1.104) and L_3 (0.841); all the treatments differing significantly from one another. The same trend was extended to the harvest stage also, wherein L_1 (0.620) recorded the highest leaf area index followed by L_2 (0.446) and

L_3 (0.261) and the three treatments differed significantly from one another.

There was significant difference in the leaf area index with respect to the time of pruning during the seventh month after planting in 'Palayankodan' but not in 'Njalipoovan'. In both the cultivars, there was significant difference in the leaf area index at bunch emergence stage, but this difference was not carried over to the harvest stage. In 'Njalipoovan' at bunch emergence stage, the highest leaf area index was recorded in I_3 (1.114) followed by I_2 (0.999); the two treatments being statistically on par with I_1 (0.929). In 'Palayankodan' during the seventh month after planting, the highest leaf area index was recorded in I_3 (1.116) followed by I_2 (1.057); the two treatments being statistically on par. The lowest leaf area index was recorded in I_1 (0.937) which was significantly lower than the other treatments. At bunch emergence stage, I_3 (1.270) recorded the highest leaf area index and it was significantly superior to all the other treatments. The treatment I_2 (1.180) which followed I_3 was significantly superior to I_1 (1.020).

The combined effect of leaf area removed and the time of pruning did not significantly affect the leaf area duration in 'Njalipoovan' or 'Palayankodan'. However the individual effects of these two treatments resulted in significant difference in leaf area duration in both the cultivars.

The comparison of the effect of leaf area removed alone showed that in 'Njalipoovan', the highest leaf area duration value was recorded in L_1 (327.56) which was followed by L_2 (286.69). The former treatment was significantly superior to the latter. L_3 (249.86) which followed L_2 differed significantly from the latter. In 'Palayankodan' also, the highest leaf area duration was recorded in L_1 (373.51) which was followed by L_2 (324.39) and L_3 (271.52). The treatment L_1 was significantly superior to L_2 while the latter was significantly superior to L_3.

The time of pruning of leaves also significantly affected the leaf area duration in both the cultivars. In 'Njalipoovan', I_3 (307.74) recorded the highest leaf area duration value followed by I_2 (286.41) and I_1 (269.97). These treatments differed significantly from one another. A similar trend was observed in 'Palayankodan' also. The highest leaf area duration value recorded in I_3 (343.79) was significantly superior to I_2 (326.30) and I_2 was significantly superior to I_1 (299.32).

The results of the study thus gave the indication that the extent of lamina removed as well as the time of removal had a significant influence on leaf area index and leaf area duration in both 'Njalipoovan' and 'Palayankodan'. Removal of more than 50 per cent leaf area prior to 30 days after unfurling had the most deleterious effect. Removal of 25 per cent leaf area 30

days after unfurling had the least harmful effect compared to other intensities of leaf pruning tested. However, it was observed in general that removal of upto 50 per cent of leaf area after 30 days of unfurling was reasonably less harmful with respect to leaf area index.

4.1.8 Effect of leaf pruning on the relative growth rate of banana cvs. Njalipoovan and Palayankodan

The results of the study on the effect of leaf pruning on the relative growth rate of banana cvs. Njalipoovan and Palayankodan based on plant height are presented in Table 8.

The data indicated that the combined effect of leaf area pruned and the time of pruning did not significantly influence the relative growth rate in both 'Njalipoovan' and 'Palayankodan'.

The extent of leaf area pruned did not significantly influence the relative growth rate in 'Njalipoovan'. However in 'Palayankodan', significant difference was observed in the relative growth rates of plants at bunch emergence stage. The highest value for relative growth rate was recorded in L_1 (0.0015 cm) followed by L_2 (0.0013 cm); the two treatments being statistically on par. The lowest value for relative growth rate was observed in L_3 (0.0009 cm) which differed significantly from the other treatments.

Table 8 Effect of leaf pruning on the relative growth rate of banana cvs. Njalipoovan and Palayankodan

Treatment	Njalipoovan: Relative growth rate ($cm\ cm^{-1}\ day^{-1}$)				Palayankodan: Relative growth rate ($cm\ cm^{-1}\ day^{-1}$)			
	Stages after planting				Stages after planting			
	3 months	5 months	7 months	At bunch emergence	3 months	5 months	7 months	At bunch emergence
L_0I_0	0.0174	0.0135	0.0062	0.0041	0.0153	0.0097	0.0059	0.0062
L_1I_1	0.0206	0.0183	0.0052	0.0033	0.0147	0.0092	0.0042	0.0009
L_1I_2	0.0178	0.0124	0.0059	0.0041	0.0160	0.0083	0.0056	0.0013
L_1I_3	0.0199	0.0121	0.0063	0.0052	0.0152	0.0086	0.0061	0.0022
L_2I_1	0.0201	0.0120	0.0048	0.0032	0.0170	0.0091	0.0041	0.0008
L_2I_2	0.0199	0.0187	0.0054	0.0043	0.0154	0.0090	0.0051	0.0012
L_2I_3	0.0200	0.0103	0.0065	0.0049	0.0146	0.0082	0.0055	0.0019
L_3I_1	0.0202	0.0126	0.0048	0.0031	0.0171	0.0090	0.0041	0.0007
L_3I_2	0.0198	0.0111	0.0048	0.0034	0.0165	0.0085	0.0047	0.0009
L_3I_3	0.0201	0.0124	0.0058	0.0031	0.0153	0.0088	0.0055	0.0012
F-test	NS	NS	NS	NS	NS	NS	NS	NS
SE	0.0016	0.0011	0.0006	0.0005	0.0011	0.0006	0.0004	0.0002
CD(0.05)	-	-	-	-	-	-	-	-
L_1	0.019	0.012	0.006	0.004	0.015	0.009	0.0053	0.0015
L_2	0.020	0.012	0.005	0.004	0.016	0.009	0.0049	0.0013
L_3	0.023	0.012	0.005	0.003	0.016	0.009	0.0048	0.0009
F-test	NS	NS	NS	NS	NS	NS	NS	*
SE	0.0014	0.0006	0.0003	0.0003	0.0007	0.0003	0.0002	0.0001
CD(0.05)	-	-	-	-	-	-	-	0.0003
I_1	0.020	0.012	0.0049	0.003	0.016	0.009	0.0041	0.0008
I_2	0.019	0.012	0.0054	0.004	0.016	0.009	0.0051	0.0011
I_3	0.020	0.012	0.0062	0.004	0.015	0.009	0.0057	0.0018
F-test	NS	NS	*	NS	NS	NS	*	**
SE	0.0009	0.0007	0.0003	0.0004	0.0004	0.0007	0.0003	0.0002
CD(0.05)	-	-	0.0009	-	-	-	0.0009	0.0003

NS - Not significant
* - Significant at 5% level

The time of leaf pruning did not significantly alter the relative growth rate in 'Njalipoovan' except during the seventh month after planting. At this stage, the relative growth rate per day was the highest in I_3 (0.0062 cm) followed by I_2 (0.0054 cm); the two treatments being statistically on par. The lowest relative growth rate was recorded in I_1 (0.0049 cm). The treatments I_1 and I_2 were statistically on par.

In 'Palayankodan', the time of leaf pruning significantly influenced the relative growth rate of plants during the seventh month after planting and at bunch emergence stage. During the seventh month after planting, the highest value for relative growth rate was recorded in I_3 (0.0057 cm) followed by I_2 (0.0051 cm); the two treatments being statistically on par. The lowest value for relative growth rate was recorded in I_1 (0.0041 cm). At bunch emergence stage, I_3 recorded the highest value for relative growth rate (0.0018 cm) which was significantly higher than the other treatments. This was followed by I_2 (0.0011 cm) and I_1 (0.0008 cm); the latter two treatments being statistically on par.

The studies indicated that the combined effect of time of pruning and the area of lamina removed had a less marked effect on the relative growth rate in both the cultivars. The individual effect of the time of pruning was more pronounced than

that of the extent of leaf area removed. In general, leaf pruning after 15 days of unfurling had less deleterious effect on the relative growth rate in both 'Njalipoovan' and 'Palayankodan'.

4.1.9 Effect of leaf pruning on the time taken for bunch emergence, bunch maturity and crop duration of banana cvs. Njalipoovan and Palayankodan

The results of the study on the effect of leaf pruning on the time taken for bunch emergence, bunch maturity and crop duration of banana cvs. Njalipoovan and Palayankodan are presented in Table 9.

The data on the combined effect of leaf area removed and the time of pruning indicated that in 'Njalipoovan', significant difference was observed in the different treatments only in the time taken for bunch maturity. The shortest duration for bunch maturity was recorded in the treatment L_3I_1 (81.08 days) followed by L_2I_3 (83.33 days) and L_3I_2 (85.32 days); the three treatments being statistically on par. The longest duration for bunch maturity was recorded in L_2I_1 (99.67 days) followed by L_1I_3 (96.33 days) and L_1I_1 (94.66 days); these three treatments being statistically on par. The duration for bunch maturity of the control plants, L_0I_0 (93.67 days) was statistically on par with L_1I_3 and L_1I_1.

Table 9 Effect of leaf pruning on the time taken for bunch emergence, bunch maturity and crop duration of banana cvs. Njalipoovan and Palayankodan

Treatment	Njalipoovan			Palayankodan		
	Time taken for bunch emergence (days)	Time taken for bunch maturity (days)	Crop duration (days)	Time taken for bunch emergence (days)	Time taken for bunch maturity (days)	Crop duration (days)
L_0I_0	278.08	93.67	371.58	290.58	108.67	399.00
L_1I_1	308.83	94.66	403.25	339.00	96.17	435.08
L_1I_2	283.25	90.08	373.33	327.08	96.66	423.75
L_1I_3	275.25	96.33	371.58	275.00	103.67	378.67
L_2I_1	305.33	99.67	405.00	336.50	96.00	432.50
L_2I_2	283.75	92.67	376.42	309.25	100.67	409.92
L_2I_3	273.92	82.33	357.25	304.33	108.00	379.00
L_3I_1	309.08	81.08	390.17	315.44	82.33	430.17
L_3I_2	304.58	85.32	389.92	345.25	82.42	427.66
L_3I_3	295.42	88.92	384.33	333.50	83.83	417.33
F-test	NS	**	NS	**	NS	NS
SE	7.47	2.09	8.18	5.82	4.59	13.36
CD(0.05)	-	5.803	-	16.154	-	-
L_1	289.11	93.69	382.72	313.69	98.83	412.50
L_2	287.67	91.89	379.56	316.69	101.56	407.14
L_3	303.03	85.11	388.14	331.40	82.86	425.06
F-test	*	*	NS	*	**	NS
SE	3.77	1.69	3.88	6.43	3.36	6.96
CD(0.05)	10.474	4.686	-	17.865	9.339	-
I_1	307.75	91.81	399.47	330.31	91.50	432.58
I_2	290.53	89.36	379.89	327.19	93.25	420.44
I_3	281.53	89.53	371.06	304.28	98.50	391.67
F-test	*	NS	*	**	NS	NS
SE	6.81	1.93	7.16	3.31	2.69	11.80
CD(0.05)	18.896	-	19.889	9.207	-	-

NS - Not significant
* - Significant at 5% level
** - Significant at 1% level

In 'Palayankodan', the combined effect of leaf area removed and the time of pruning had significant effect on the time taken for bunch emergence. The time taken for bunch maturity and crop duration were not significantly influenced. The time taken for bunch emergence of the control plants (290.58 days) was significantly lower than the corresponding mean value of the treated plants. The shortest duration for bunch emergence was recorded in the treatment L_1I_3 (275 days) followed by L_0I_0 (290.58 days); the two treatments being statistically on par. This was followed by L_2I_3 (304.33 days). The treatments L_0I_0 and L_2I_3 were statistically on par. This was followed by L_2I_2 (309.25 days) and L_3I_1 (315.44 days); the two treatments being statistically on par with L_2I_3. The longest duration for bunch emergence was recorded in L_3I_2 (345.25 days) followed by L_1I_1 (339 days), L_2I_1 (336.50 days) and L_3I_3 (333.50 days); the four treatments being statistically on par.

The extent of leaf area pruned had a significant influence on the time taken for bunch emergence and bunch maturity in both 'Njalipoovan' and 'Palayankodan'. The crop duration in both the varieties was not significantly influenced. In 'Njalipoovan', the treatment L_2 recorded the shortest duration for bunch emergence (287.67 days) followed by L_1 (289.11 days); the two treatments being statistically on par. The longest duration for bunch emergence was recorded in L_3 (303.03 days).

The shortest duration for bunch maturity was recorded in L_3 (85.11 days). This was followed by L_2 (91.89 days) and L_1 (93.69 days); the latter two treatments being statistically on par.

In 'Palayankodan', the shortest duration for bunch emergence was observed in the treatment L_1 (313.69 days) followed by L_2 (316.69 days). L_1 and L_2 were statistically on par. The longest duration for bunch emergence was recorded in L_3 (331.40 days). The time taken for bunch maturity was the shortest in L_3 (82.86 days) followed by L_1 (98.83 days) and L_2 (101.56 days). The latter two treatments were statistically on par.

There was significant difference in the time taken for bunch emergence in 'Njalipoovan' and 'Palayankodan' with respect to the time of pruning. The time taken for bunch maturity was not significantly influenced in both the cultivars. The crop duration was significantly altered in 'Njalipoovan' but not in 'Palayankodan'. In 'Njalipoovan', the shortest duration for bunch emergence was observed in I_3 (281.53 days) followed by I_2 (290.53 days) and I_1 (307.75 days). I_3 and I_2 were statistically on par and so were I_2 and I_1. The crop duration was the shortest in the treatment I_3 (371.06 days) and I_2 (379.89 days) and I_1 (399.47 days). The treatments I_3 and I_2 were statistically on par. In 'Palayankodan' the shortest duration for bunch emergence

was recorded in I_3 (304.28 days). This was followed by I_2 (327.19 days) and I_1 (330.31 days); the two treatments being statistically on par but significantly different from I_3.

The studies indicated that the time taken for bunch emergence and bunch maturity were influenced by the leaf pruning treatments. The combined effect showed that when the extent of lamina removed increased or the period of retention was shorter, the time for bunch emergence increased but for bunch maturity decreased. But the crop duration in general was not affected by leaf pruning.

The time taken for bunch emergence in both the varieties was shorter when only 25-50 per cent of the lamina was removed. But the bunch maturity period was longer in these levels of pruning. When the time of retention was 30 days after unfurling, in both cultivars, the duration for bunch emergence was shorter. Only in 'Njalipoovan', the crop duration was affected by the time of pruning of leaves. It was observed that the crop duration decreased when the leaves were retained for 15-30 days after unfurling.

4.1.10 Effect of leaf pruning on the number of suckers produced in banana cvs. Njalipoovan and Palayankodan

Results of the study are presented Table 10.

Table 10 Effect of leaf pruning on the number of suckers produced in banana cvs. Njalipoovan and Palayankodan

Treatment	Njalipoovan	Palayankodan
	Number of suckers per plant	Number of suckers per plant
L_0I_0	5.17	4.92
L_1I_1	4.42	4.08
L_1I_2	4.58	4.50
L_1I_3	5.17	4.83
L_2I_1	4.16	3.82
L_2I_2	4.75	4.25
L_2I_3	4.91	4.33
L_3I_1	3.33	2.50
L_3I_2	4.00	3.25
L_3I_3	4.16	3.50
F-test	NS	NS
SE	0.17	0.26
CD(0.05)	-	-
L_1	4.72	4.47
L_2	4.61	4.14
L_3	3.83	3.08
F-test	**	**
SE	0.15	0.21
CD(0.05)	0.4153	0.5701
I_1	3.97	3.47
I_2	4.44	4.00
I_3	4.75	4.22
F-test	*	*
SE	0.14	0.15
CD(0.05)	0.3932	0.4270

NS - Not significant
* - Significant at 5% level
** - Significant at 1% level

The data on the combined effect of extent of leaf area pruned and the time of pruning indicated that the number of suckers produced was not significantly influenced by the leaf pruning treatments in 'Njalipoovan' or 'Palayankodan'.

The extent of leaf area pruned significantly influenced the number of suckers produced in 'Njalipoovan' and 'Palayankodan'. In 'Njalipoovan', the treatment L_1 recorded the highest number of suckers (4.72) followed by L_2 (4.61); the two treatments being statistically on par. The lowest number of suckers was recorded in L_3 (3.83). In 'Palayankodan', the highest number of suckers was recorded in L_1 (4.47) followed by L_2 (4.14); the two treatments being statistically on par. The lowest number of suckers was recorded in L_3 (3.08).

The time of leaf pruning significantly influenced the number of suckers produced in both the varieties. In 'Njalipoovan', the highest number of suckers was recorded in I_3 (4.75) followed by I_2 (4.44). I_3 and I_2 were statistically on par. This was followed by I_1 (3.97) which was significantly lower than I_3 and I_2. In 'Palayankodan', I_3 recorded the highest number of suckers (4.22) followed by I_2 (4.00); the two treatments being statistically on par. The lowest number of suckers was recorded in I_1 (3.47).

The above results indicated that the combined effect of leaf area pruned and the time of pruning was not having a marked influence in sucker production. However, when the individual effects were considered, removal of 25 to 50 per cent leaf area 15-30 days after unfurling resulted in more number of suckers per plant.

4.1.11 Effect of leaf pruning on the dry matter production of banana cvs. Njalipoovan and Palayankodan

Data on the influence of leaf pruning on dry matter production in banana cv. Njalipoovan are presented in Table 11 and Fig. 5 and the results of the study on cv. Palayankodan are presented in Table 12 and Fig. 6.

In 'Njalipoovan', the combined effect of leaf area removed and the time of pruning indicated that the dry weight of corm, pseudostem, leaf and leaf sheath in the different treatments were not significantly altered. However, there was significant difference with respect to the dry weight of the bunches, the total dry weight per plant and the total dry matter production per hectare. The dry weight of the bunch (2.754 kg), total dry weight per plant (5.412 kg) and the total dry matter production per hectare (11.923 t) of the control plants were significantly higher than the respective mean values of the treated plants. The dry weight of the bunches was the highest in

Table 11 Effect of leaf pruning on the dry matter production in banana cv. Njalipoovan

Treatment	Plant parts (Dry weight)						
	Corm (g)	Pseudo-stem (g)	Leaf (g)	Leaf sheath (g)	Bunch (kg)	Total dry weight kg plant^{-1}	Total dry matter production t ha^{-1}
L_0I_0	632.23	267.47	1362.80	395.17	2.754	5.412	11.923
L_1I_1	552.56	263.80	1140.63	374.53	2.618	4.949	10.910
L_1I_2	563.43	269.00	1160.60	383.03	2.453	4.830	10.643
L_1I_3	598.00	259.10	1259.83	388.17	2.378	4.883	10.760
L_2I_1	547.70	245.87	962.23	321.77	2.427	4.504	9.927
L_2I_2	557.13	250.10	979.87	352.36	1.929	4.068	8.967
L_2I_3	557.27	255.83	1072.36	360.73	2.360	4.606	10.153
L_3I_1	511.26	234.33	727.30	316.03	1.393	3.202	7.057
L_3I_2	519.52	243.36	918.03	324.80	1.388	3.394	7.480
L_3I_3	528.20	256.70	976.07	316.80	2.144	4.222	9.306
F-test	NS	NS	NS	NS	**	*	*
SE	16.13	5.17	86.30	10.72	0.14	0.16	0.34
CD(0.05)	-	-	-	-	0.3762	0.4325	0.9510
L_1	571.33	263.97	1187.02	381.91	2.483	4.888	10.771
L_2	554.03	250.60	1004.82	344.96	2.239	4.393	9.682
L_3	519.67	244.80	873.80	319.21	1.642	3.606	7.948
F-test	**	*	*	**	**	**	**
SE	6.86	3.36	63.08	2.68	0.11	0.11	0.24
CD(0.05)	19.037	9.343	175.10	7.432	0.307	0.310	0.682
I_1	537.18	254.16	943.39	337.44	2.146	4.219	9.298
I_2	546.70	254.16	1019.50	353.40	1.924	4.097	9.030
I_3	561.16	257.21	1102.76	355.23	2.294	4.571	10.073
F-test	*	NS	*	NS	*	*	*
SE	6.28	2.91	42.14	6.75	0.10	0.12	0.27
CD(0.05)	17.42	-	116.970	-	0.2750	0.3445	0.7574

NS - Not significant
* - Significant at 5% level
** - Significant at 1% level

L_0I_0 (2.574 kg). This was followed by L_1I_1 (2.618 kg), L_1I_2 (2.453 kg), L_2I_1 (2.427 kg) and L_1I_3 (2.378 kg); the four treatments being statistically on par with L_0I_0. The lowest bunch dry weight was recorded in L_3I_2 (1.388 kg) followed by L_3I_1 (1.393 kg). L_3I_2 and L_3I_1 were statistically on par. The total dry weight of the plants was also significantly influenced. The highest total dry weight per plant was recorded in L_0I_0 (5.412 kg) followed by L_1I_1 (4.949 kg); the two treatments being statistically on par. This was followed by L_1I_3 (4.883 kg), L_1I_2 (4.830 kg) and L_2I_3 (4.606 kg); the three treatments being statistically on par with L_1I_1. The lowest dry weight per plant was recorded in L_3I_1 (3.202 kg) followed by L_3I_2 (3.394 kg); the two treatments being statistically on par. The total dry matter production per hectare showed the same trend. L_0I_0 (11.923 t) recorded the highest total dry matter production per hectare. This was followed by L_1I_1 (10.910 t). L_0I_0 and L_1I_1 were statistically on par. The treatments L_1I_3 (10.760 t), L_1I_2 (10.643 t) and L_2I_3 (10.153 t) were statistically on par with L_1I_1. The dry matter production per hectare was the lowest in L_3I_1 (7.057 t) followed by L_3I_2 (7.480 t); the two treatments being statistically on par.

The extent of leaf area removed significantly influenced the dry weight of corm, pseudostem, leaf, leaf sheath and bunch in 'Njalipoovan'. The total dry weight of the plants

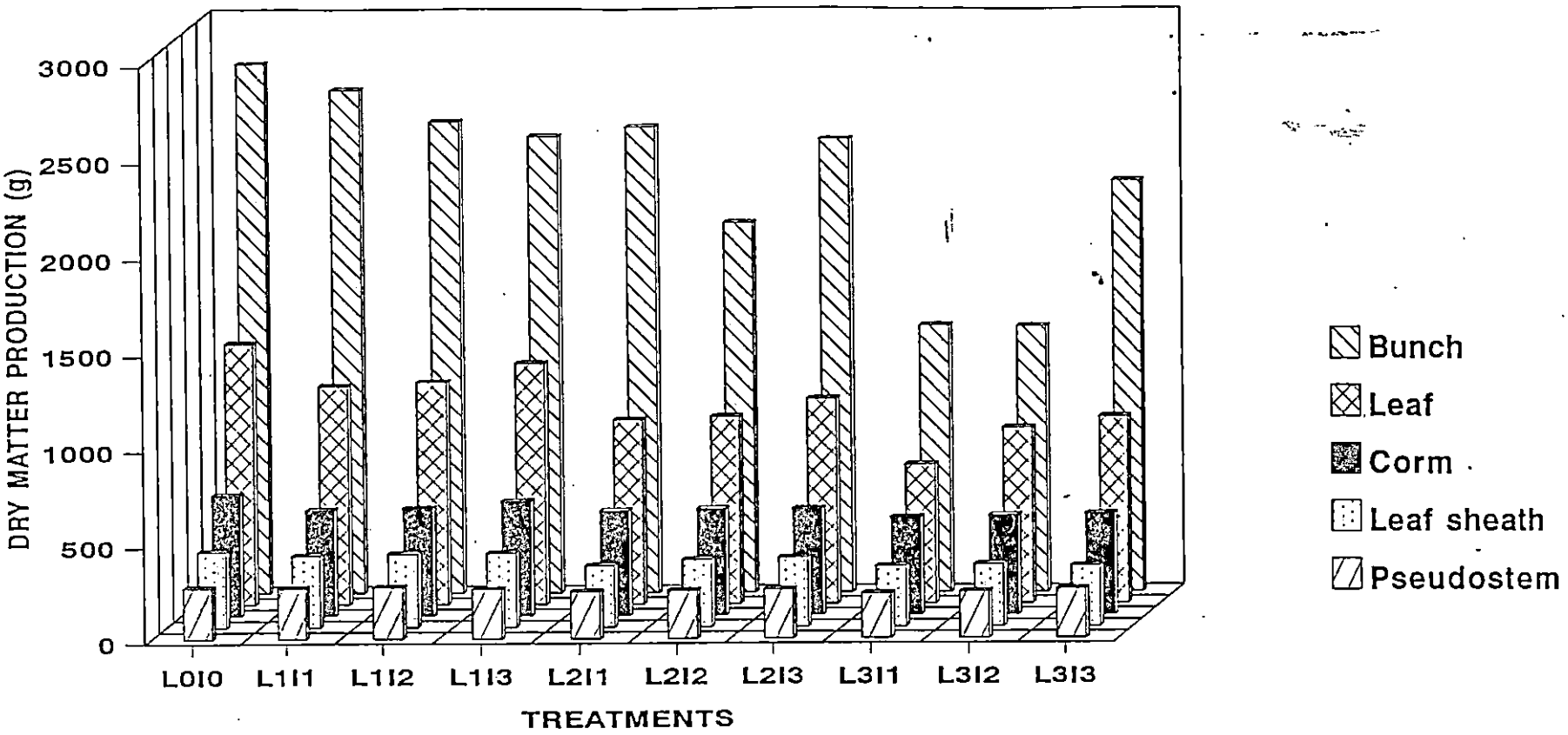


Fig. 5. Effect of leaf pruning on dry matter production in banana cv. Njalipoovan

and the total dry matter production per hectare were also affected. The dry weight of the corms was the highest in L_1 (571.33 g) followed by L_2 (554.03 g); the two treatments being statistically on par. The lowest value was recorded in L_3 (519.67 g). The dry weight of pseudostem was the highest in L_1 (263.97 g). This was significantly superior to L_2 (250.60 g) and L_3 (244.80 g). L_2 and L_3 were statistically on par. The dry weight of the leaf was the highest in L_1 (1187.02 g) followed by L_2 (1004.82 g) and L_3 (873.80 g). The latter two treatments were statistically on par. The dry weight of the leaf sheath was the highest in L_1 (381.91 g) followed by L_2 (344.96 g) and L_3 (319.21 g). The three treatments differed significantly from one another. The bunch dry weight was the highest in L_1 (2.483 kg) followed by L_2 (2.239 kg); the two treatments being statistically on par. The lowest bunch dry weight was recorded in L_3 (1.642 kg). The total dry weight of the plants was the highest in L_1 (4.888 kg) followed by L_2 (4.393 kg) and L_3 (3.606 kg). The three treatments differed significantly from one another. The total dry matter production expressed on per hectare basis showed a pattern similar to that of the total dry weight of the plants. The highest total dry matter production per hectare was recorded in L_1 (10.771 t) followed by L_2 (9.682 t) and L_3 (7.948 t). The three treatments differed significantly from one another.

The time of leaf pruning significantly influenced the dry weight of the corm, leaf and bunch in 'Njalipoovan'. The total dry weight of the plants and the total dry matter production per hectare were also significantly influenced. The dry weight of the corms was the highest in I_3 (561.16 g) followed by I_2 (546.70 g); the two treatments being statistically on par. The lowest dry weight of the corms was recorded in I_1 (537.18 g) which was statistically on par with I_2. The dry weight of the leaves was the highest in I_3 (1102.76 g) followed by I_2 (1019.50 g); the two treatments being statistically on par. The lowest dry weight of the leaves was recorded in I_1 (943.39 g). I_1 was statistically on par with I_2. The bunch dry weight was the highest in I_3 (2.294 kg) followed by I_1 (2.146 kg); the two treatments being statistically on par. The lowest bunch dry weight was recorded in I_2 (1.924 kg). I_2 was statistically on par with I_1. The total dry weight of the plants was the highest in I_3 (4.571 kg). This was followed by I_1 (4.219 kg) and I_2 (4.097 kg); the two treatments being statistically on par. The total dry matter production expressed on per hectare basis showed a pattern similar to that of the total dry weight of the plants. The dry matter production per hectare was the highest in I_3 (10.073 t) followed by I_1 (9.298 t) and I_2 (9.030 t). The latter two treatments were statistically on par.

The data on the combined effect of leaf area removed and the interval of pruning in 'Palayankodan' indicated that there was significant difference only in the dry weight of corms in the different treatments. There was no significant difference in the dry weight of pseudostem, leaf, leaf sheath and bunch of the plants. The total dry weight of the plants and the total dry matter production per hectare also were not significantly influenced by the leaf pruning treatments imposed. The dry weight of the corms was the highest in L_0I_0 (629.73 g) followed by L_1I_3 (620.57 g) and L_1I_2 (618.26 g). The three treatments were statistically on par. This was followed by L_1I_1 (586.03 g) which was significantly lower than L_1I_2. The lowest dry weight of corms was recorded in L_3I_3 (416.43 g) followed by L_3I_1 (461.47 g). The two treatments were significantly different from one another. L_3I_1 was statistically on par with L_3I_2 (475.73 g).

The extent of leaf area removed significantly influenced the dry weight of corm, pseudostem, leaf, leaf sheath and bunch in 'Palayankodan'. The total dry weight of the plants and the total dry matter production per hectare also differed significantly. The treatment L_1 recorded the highest corm dry weight (608.28 g) followed by L_2 (538.18 g) and L_3 (451.21 g). The three treatments differed significantly from one another. The dry weight of the pseudostem was the highest in L_1 (287.16 g) followed by L_2 (275.66 g) and L_3 (256.58 g). The three treatments were significantly different from one another. The

Table 12 Effect of leaf pruning on the dry matter production in banana cv. Palayankodan

Treatment	Plant parts (Dry weight)						
	Corm (g)	Pseudo-stem (g)	Leaf (kg)	Leaf sheath (g)	Bunch (kg)	Total dry weight kg plant^{-1}	Total dry matter production t ha^{-1}
L_0I_0	629.73	298.07	1.825	459.10	3.384	6.562	14.536
L_1I_1	586.03	275.10	1.695	345.83	2.049	4.972	10.960
L_1I_2	618.26	288.76	1.739	407.73	1.961	5.015	11.053
L_1I_3	620.57	297.60	1.732	382.22	2.262	5.295	11.670
L_2I_1	519.26	278.80	1.668	341.74	1.704	4.497	9.913
L_2I_2	548.26	278.80	1.589	358.67	1.774	4.549	10.023
L_2I_3	547.00	282.90	1.514	366.20	1.805	4.515	9.952
L_3I_1	461.47	250.73	1.111	304.83	1.485	3.614	7.964
L_3I_2	475.73	253.20	1.156	325.80	1.288	3.500	7.716
L_3I_3	416.43	265.80	1.145	330.13	1.392	3.549	7.824
F-test	**	NS	NS	NS	NS	NS	NS
SE	8.53	4.03	0.08	14.02	0.10	0.09	0.21
CD(0.05)	23.694	-	-	-	-	-	-
L_1	608.28	287.16	1.722	378.60	2.091	5.094	11.288
L_2	538.18	275.66	1.590	355.53	1.761	4.521	9.963
L_3	451.21	256.58	1.138	320.56	1.389	3.555	7.834
F-test	**	**	**	**	*	**	**
SE	8.19	4.03	0.06	1.35	0.13	0.14	0.31
CD(0.05)	22.732	11.181	0.1700	3.744	0.3530	0.3960	0.8707
I_1	522.26	263.70	1.492	330.80	1.746	4.361	9.612
I_2	547.42	273.59	1.495	364.07	1.675	4.355	9.598
I_3	528.00	282.10	1.464	359.52	1.820	4.454	9.816
F-test	*	**	NS	**	NS	NS	NS
SE	4.67	3.02	0.05	5.34	0.06	0.04	0.08
CD(0.05)	12.971	8.373	-	14.813	-	-	-

NS - Not significant
* - Significant at 5% level
** - Significant at 1% level

dry weight of the leaf was the highest in L_1 (1.722 kg) followed by L_2 (1.590 kg) and L_3 (1.138 kg). The former two treatments were statistically on par and significantly superior to L_3. The dry weight of the leaf sheath was the highest in L_1 (378.60 g) followed by L_2 (355.53 g) and L_3 (320.56 g). The three treatments differed significantly from one another. The bunch dry weight was the highest in the treatment L_1 (2.091 kg) followed by L_2 (1.761 kg); the two treatments being statistically on par. The lowest bunch dry weight was recorded in L_3 (1.389 kg). The total dry weight of the plants was the highest in L_1 (5.094 kg) followed by L_2 (4.521 kg) and L_3 (3.555 kg). The three treatments were significantly different from one another. The total dry matter production per hectare showed a pattern similar to that of the total dry weight per plant. The highest total dry matter production per hectare was observed in L_1 (11.288 t) followed by L_2 (9.963 t) and L_3 (7.834 t). The three treatments differed significantly from one another.

The time of leaf pruning significantly influenced the dry weight of the corm, pseudostem and leaf sheath in 'Palayankodan'. The dry weight of the corms was the highest in I_2 (547.42 g). This was followed by I_3 (528.00 g) and I_1 (522.26 g). I_3 and I_1 were statistically on par. The dry weight of the pseudostem was the highest in I_3 (282.10 g) followed by I_2 (273.59 g) and I_1 (263.70 g). The three treatments differed

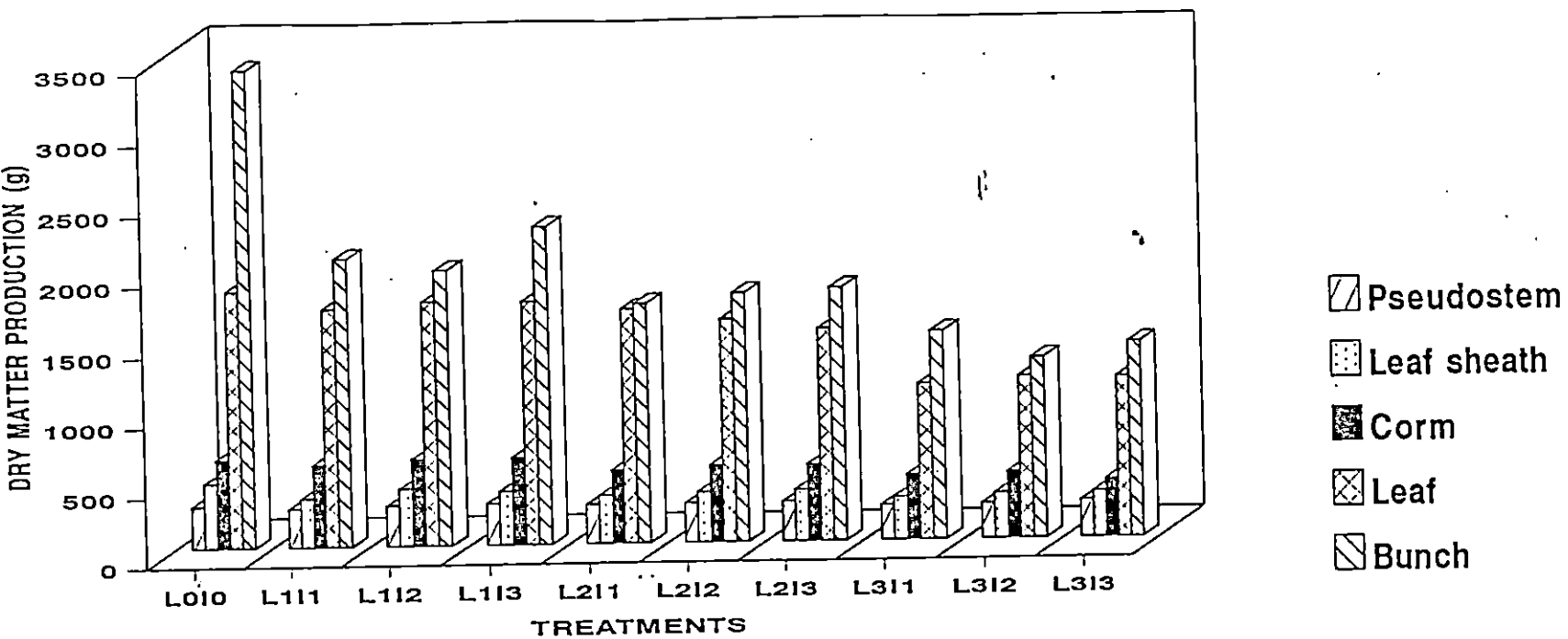


Fig. 6. Effect of leaf pruning on dry matter production in banana cv. Palayankodan

significantly from one another. The dry weight of the leaf sheath was the highest in I_2 (364.07g) followed by I_3 (359.52 g); the two treatments being statistically on par. The lowest dry weight of leaf sheath was recorded in I_1 (330.80 g).

The above results gave the indication that in 'Njalipoovan', the dry matter production in the bunches, in the plants, and on per hectare basis was lowered due to the combined effect of the area of the lamina pruned and the time of pruning. In general, irrespective of the time of pruning, 25-50 per cent of the lamina removed had less deleterious effect on the dry matter production. The individual effects of the extent of pruning and the period of retention of leaf area were more pronounced than their combined effect. Removal of 25-50 per cent of the leaf area 15 to 30 days after unfurling resulted in comparatively higher dry matter production in the various plant parts as well as the whole plant.

In 'Palayankodan', the combined effect of extent of leaf area removed and time of pruning had no significant effect on dry matter production except in the corms wherein removal of upto 25 per cent leaf area 15 to 30 days after unfurling resulted in higher dry matter production. The individual effect of the leaf area pruned revealed that removal of 25 per cent leaf area had less adverse effect on dry matter production. Pruning of

leaves prior to 15 days after unfurling had affected the dry matter production in 'Palayankodan'.

Thus considering the effect of leaf pruning on both the varieties, it appears that removal of more than 50 per cent of the leaf area prior to 15 days of unfurling adversely affected the dry matter production.

4.2 Effect of leaf pruning on the yield characters of banana cvs. Njalipoovan and Palayankodan

4.2.1 Effect of leaf pruning on the mean bunch weight, number of hands and fingers of banana cvs. Njalipoovan and Palayankodan

Results of the study are presented in Table 13 and plates 1, 2, 3 and 4.

The data indicated that the combined effect of leaf area pruned and the time of pruning did not significantly influence the mean bunch weight and the number of hands and fingers in 'Njalipoovan'. In 'Palayankodan', the number of fingers per bunch, the mean bunch weight and total bunch yield per hectare were significantly influenced while the number of hands per bunch was not significantly altered.

In 'Palayankodan', the highest number of fingers per bunch was recorded in L_0I_0 (191.42). This was significantly

Table 13 Effect of leaf pruning on the mean bunch weight, number of hands and fingers of banana cvs. Njalipoovan and Palayankodan

Treatment	Njalipoovan				Palayankodan			
	Number of hands per bunch	Number of fingers per bunch	Mean bunch weight (kg plant^{-1})	Total bunch yield (t ha^{-1})	Number of hands per bunch	Number of fingers per bunch	Mean bunch weight (kg plant^{-1})	Total bunch yield (t ha^{-1})
L_0I_0	8.00	182.67	8.62	19.00	10.67	191.42	9.43	20.78
L_1I_1	7.16	161.33	5.16	11.39	8.83	163.42	7.41	16.34
L_1I_2	7.16	165.91	6.17	13.60	8.75	181.25	8.51	18.75
L_1I_3	7.75	174.42	6.69	14.74	9.83	184.75	8.57	18.88
L_2I_1	6.75	144.75	4.68	10.32	8.50	164.83	6.41	14.12
L_2I_2	6.75	153.75	4.83	10.65	8.83	170.92	7.10	15.65
L_2I_3	7.17	155.25	5.29	11.65	9.83	174.25	7.11	15.67
L_3I_1	6.08	134.08	3.19	7.03	7.08	154.42	4.22	9.31
L_3I_2	5.92	145.25	3.91	8.61	7.16	160.91	4.38	9.66
L_3I_3	7.08	151.92	5.08	11.19	8.50	166.50	5.90	13.01
F-test	NS	NS	NS	NS	NS	*	**	**
SE	0.14	3.12	0.32	3.12	0.23	2.14	0.20	2.14
CD(0.05)	-	-	-	-	-	5.9263	0.557	1.232
L_1	7.36	167.22	6.00	13.24	9.14	176.47	8.16	17.99
L_2	6.88	151.25	4.93	10.87	9.05	170.00	6.87	15.17
L_3	6.36	143.75	4.05	8.94	7.58	160.61	4.87	10.66
F-test	**	**	**	**	**	**	**	**
SE	0.07	3.07	0.12	3.07	0.16	1.20	0.17	1.20
CD(0.05)	0.199	8.521	0.312	0.686	0.433	3.324	0.470	1.03
I_1	6.67	146.72	4.34	9.58	8.14	160.89	6.02	13.26
I_2	6.61	154.97	4.97	10.95	8.25	171.03	6.66	14.69
I_3	7.33	160.53	5.68	12.53	9.39	175.17	7.19	15.85
F-test	**	*	**	**	**	**	**	**
SE	0.13	2.67	0.13	2.67	0.17	1.20	0.17	1.20
CD(0.05)	0.367	7.410	0.355	0.783	0.473	3.340	0.476	1.052

NS - Not significant
* - Significant at 5% level
** - Significant at 1% level

superior to all the other treatments. Next to L_0I_0, the highest number of fingers per bunch was recorded in L_1I_3 (184.75) followed by L_1I_2 (181.25); the two treatments being statistically on par. This was followed by L_2I_3 (174.25) and L_2I_2 (170.92). L_2I_3 and L_2I_2 were statistically on par. The lowest number of fingers per bunch was recorded in L_3I_1 (154.42) and this was significantly lower than all the other treatments. L_3I_2 (160.91), L_2I_1 (163.42), L_2I_3 (164.83) and L_3I_3 (166.50) were statistically on par and significantly superior to L_3I_1.

The mean bunch weight in 'Palayankodan' was the highest in L_0I_0 (9.43 kg). The treatment L_1I_3 (8.57 kg) which followed L_0I_0 was statistically on par with L_1I_2 (8.51 kg). The treatments L_1I_1 (7.41 kg), L_2I_3 (7.11 kg) and L_2I_2 (7.10 kg) followed L_1I_2 and the former three treatments were statistically on par. The lowest mean bunch weight was observed in L_3I_1 (4.22 kg). The treatment L_3I_2 (4.38 kg) was statistically on par with L_3I_1. The total bunch yield per hectare showed the same trend as the mean bunch weight. The highest total bunch yield per hectare was observed in L_0I_0 (20.78 t) followed by L_1I_3 (18.88 t) and L_1I_2 (18.75 t); the latter two treatments being statistically on par. This was followed by L_1I_1 (16.34 t), L_2I_3 (15.67 t) and L_2I_2 (15.65 t). The three treatments were statistically on par. The lowest total bunch yield per hectare was recorded in L_3I_1 (9.31 t). L_3I_1 was statistically on par with L_3I_2 (9.66 t).

The extent of leaf area removed significantly influenced the number of hands per bunch, the number of fingers per bunch, the mean bunch weight per plant and the total bunch yield per hectare in both 'Njalipoovan' and 'Palayankodan'. In 'Njalipoovan', the number of hands per bunch was the highest in L_1 (7.36) followed by L_2 (6.88) and L_3 (6.36). The three treatments differed significantly fron one another. The highest number of fingers per bunch was recorded in L_1 (167.22) followed by L_2 (151.25) and L_3 (143.75); the latter two treatments being statistically on par. The mean bunch weight of the plants and the total bunch yield per hectare showed a similar trend. The highest mean bunch weight was recorded in L_1 (6.00 kg). This was followed by L_2 (4.93 kg) and L_3 (4.05 kg). The three treatments were significantly different from one another. The total bunch yield per hectare was the highest in L_1 (13.24 t) followed by L_2 (10.87 t) and L_3 (8.94 t); the three treatments being significantly different from one another.

In 'Palayankodan', the number of hands per bunch was the highest in L_1 (9.14) followed by L_2 (9.05); the two treatments being statistically on par. The lowest number of hands per bunch was recorded in L_3 (7.58). The highest number of fingers per bunch was recorded in L_1 (176.47) followed by L_2 (170.00) and L_3 (160.61). The three treatments were

significantly different from one another. The mean bunch weight of the plant and the total bunch yield per hectare also showed a similar trend. The mean bunch weight was the highest in L_1 (8.16 kg) followed by L_2 (6.87 kg) and L_3 (4.87 kg); the three treatments being significantly different from one another. The total bunch yield per hectare was the highest in L_1 (17.99 t) followed by L_2 (15.17 t) and L_3 (10.66 t); the three treatments being significantly different from one another.

The time of leaf pruning had significant effect on the number of hands per bunch, number of fingers per hand, mean bunch weight and the total bunch yield per hectare in both 'Njalipoovan' and 'Palayankodan'. The highest number of hands per bunch in 'Njalipoovan' was recorded in the treatment I_3 (7.33) followed by I_1 (6.67) and I_2 (6.61); the latter two treatments being statistically on par. The number of fingers per bunch was the highest in I_3 (160.53) followed by I_2 (154.97) and I_1 (146.72); the former two treatments being statistically on par. The mean bunch weight was the highest in I_3 (5.68 kg) followed by I_2 (4.97 kg) and I_1 (4.34 kg). The three treatments significantly differed from one another. The total bunch yield per hectare showed a trend similar to that of the mean bunch weight of the plants. The highest total bunch yield per hectare was observed in I_3 (12.53 t) followed by I_2 (10.95 t) and I_1

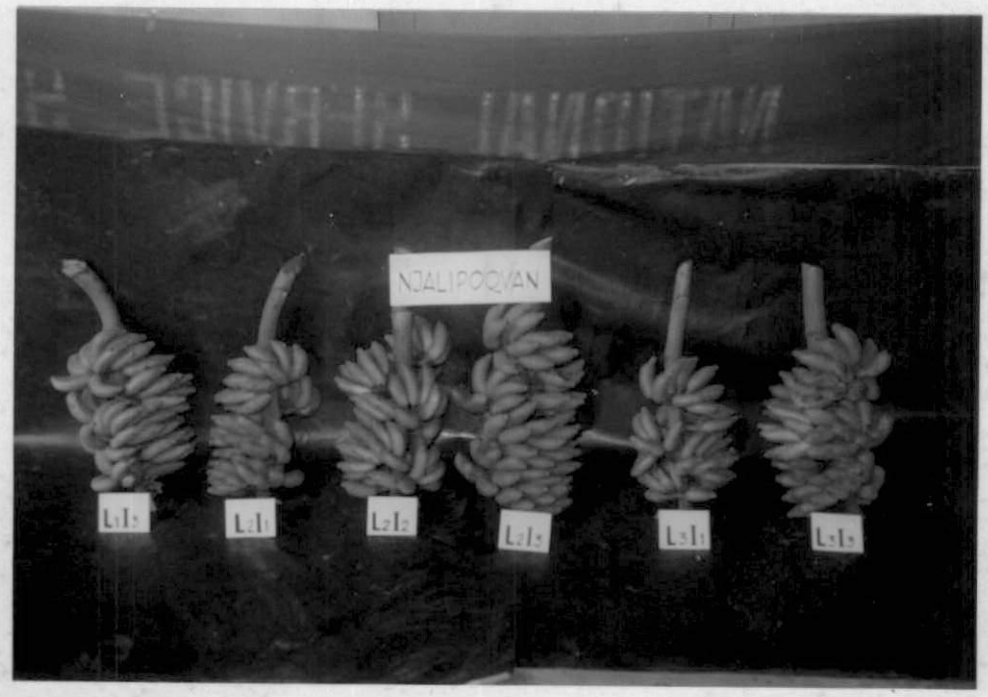
(9.58 t); the three treatments being significantly different from one another.

In 'Palayankodan', the number of hands per bunch was the highest in the treatment I_3 (9.39) followed by I_2 (8.25) and I_1 (8.14); the latter two treatments being statistically on par. The number of fingers per bunch was the highest in I_3 (175.17). This was followed by I_2 (171.03) and I_1 (160.89). The three treatments significantly differed from one another. The yield per hectare also recorded a similar trend. The highest mean bunch weight was recorded in I_3 (7.19 kg) followed by I_2 (6.66 kg) and I_1 (6.02 kg); the three treatments being significantly different from one another. The total bunch yield per hectare was the highest in I_3 (15.85 t) followed by I_2 (14.69 t) and I_1 (13.26 t). The three treatments were significantly different from one another.

The results of the studies on the effect of leaf pruning on the bunch characters of banana cvs. Njalipoovan and Palayankodan indicated that, in 'Palayankodan' leaf pruning treatments imposed had more influence on bunch characters than in 'Njalipoovan'. In 'Palayankodan' no leaf pruning resulted in the highest yield in terms of number of fingers and bunch weight. In general, removal of upto 25 per cent leaf area 15 to 30 days after unfurling helped to retard the extent of yield reduction.

Plates 1 & 2 Effect of leaf pruning on bunch yield of banana cv. Njalipoovan.


NJALIPOOVAN
L0I0
L1I1
L2I2
L3I2


NJALIPOOVAN

Plates 3 & 4 Effect of leaf pruning on bunch yield of banana cv. Palayankodan.


PALAYANKODAN
L1I2
L2I1
L3I1
L3I2


PALAYANKODAN

The individual effects of extent of leaf area pruned or the time of pruning were marked on both the varieties. Removal of 25 per cent of the leaf area after 30 days of unfurling had comparatively less deleterious effect on the number of hands, fingers, bunch weight and yield per hectare.

4.2.2 Effect of leaf pruning on the fruit characters of banana cvs. Njalipoovan and Palayankodan

The results of the study on the effect of leaf pruning on fruit characters of 'Njalipoovan' are given in Table 14 and Fig. 7 and the results of the study on 'Palayankodan' are given in Table 15 and Fig. 8.

The combined effect of leaf area removed and time of pruning had significant effect on the finger weight, pulp weight, peel weight and the pulp/peel ratio of the fruits in 'Njalipoovan'. The finger length and finger girth were not significantly influenced by the treatments. The finger weight (51.49 g), pulp weight (38.97 g) and peel weight (10.66 g) of the control plants were significantly superior to the corresponding mean values of the treated plants in 'Njalipoovan'.

The highest finger weight was recorded in L_0I_0 (51.49g) in 'Njalipoovan' which was significantly superior to other

Table 14 Effect of leaf pruning on the fruit characters of banana cv. Njalipoovan

Treatment	Finger length (cm)	Finger girth (cm)	Finger weight (g)	Pulp weight (g)	Peel weight (g)	Pulp/peel ratio
L_0I_0	10.53	9.75	51.49	38.97	10.66	3.68
L_1I_1	8.62	8.26	36.39	30.10	8.89	3.40
L_1I_2	9.12	8.26	41.87	32.33	10.07	3.21
L_1I_3	9.39	8.35	45.05	32.05	9.62	3.33
L_2I_1	8.59	8.16	41.83	22.34	8.36	2.67
L_2I_2	8.76	8.20	40.50	31.64	8.90	3.57
L_2I_3	8.48	8.11	46.28	31.58	9.38	3.37
L_3I_1	7.21	7.62	24.29	17.68	8.05	2.19
L_3I_2	7.66	7.81	25.48	22.15	7.52	2.94
L_3I_3	8.66	8.14	32.12	19.74	7.89	2.38
F-test	NS	NS	*	*	**	*
SE	0.258	0.174	0.964	1.405	0.184	0.173
CD(0.05)	-	-	2.675	3.859	0.5123	0.4848
L_1	9.04	8.29	42.10	31.49	9.52	3.31
L_2	8.61	8.15	42.87	28.52	8.88	3.21
L_3	7.84	7.86	27.29	19.86	7.82	2.50
F-test	**	*	**	**	**	**
SE	0.120	0.083	0.249	0.612	0.178	0.058
CD(0.05)	0.3308	0.2306	0.6855	1.656	0.4932	0.1587
I_1	8.14	8.02	34.17	23.37	8.43	2.76
I_2	8.51	8.09	35.95	28.71	8.83	3.24
I_3	8.84	8.20	41.15	27.79	8.96	3.03
F-test	*	NS	**	*	NS	NS
SE	0.122	0.105	0.342	1.466	0.288	0.177
CD(0.05)	0.3382	-	0.9467	4.068	-	-

NS - Not significant
* - Significant at 5% level
** - Significant at 1% level

treatments. This was followed by L_2I_3 (46.28 g) and L_1I_3 (45.05 g); the two treatments being statistically on par. The treatment L_1I_2 (41.87 g) which followed L_1I_3 was statistically on par with L_2I_1 (41.83 g) and L_2I_2 (40.50 g). The lowest finger weight was observed in L_3I_1 (24.29 g) followed by L_3I_2 (25.48 g); the two treatments being statistically on par. This was followed by the treatment L_3I_3 (32.12 g). The pulp weight was the highest in L_0I_0 (38.97 g) which was significantly superior to all other treatments. This was followed by L_1I_2 (32.33 g), L_1I_3 (32.05 g), L_2I_2 (31.64 g), L_2I_3 (31.58 g) and L_1I_1 (30.10 g); the five treatments being statistically on par. The lowest pulp weight was recorded in L_3I_1 (17.68 g) followed by L_3I_3 (19.74 g). The two treatments were statistically on par. L_3I_3 was statistically on par with L_3I_2 (22.15 g) and L_2I_1 (22.34 g). The highest peel weight was recorded in L_0I_0 (10.66 g) which was significantly superior to all other treatments. This was followed by L_1I_2 (10.07 g), L_1I_3 (9.62 g) and L_2I_3 (9.38 g). The former two treatments were statistically on par and so were the latter two. The lowest peel weight was recorded in L_3I_2 (7.52 g) followed by L_3I_3 (7.89 g); the two treatments being statistically on par. L_3I_3 was statistically on par with L_3I_1 (8.05 g) and L_2I_1 (8.36 g). The pulp/peel ratio was the highest in L_0I_0 (3.68) which was statistically on par with L_2I_2 (3.57), L_1I_1 (3.40), L_2I_3 (3.37), L_1I_3 (3.33) and L_1I_2 (3.21). The six treatments were

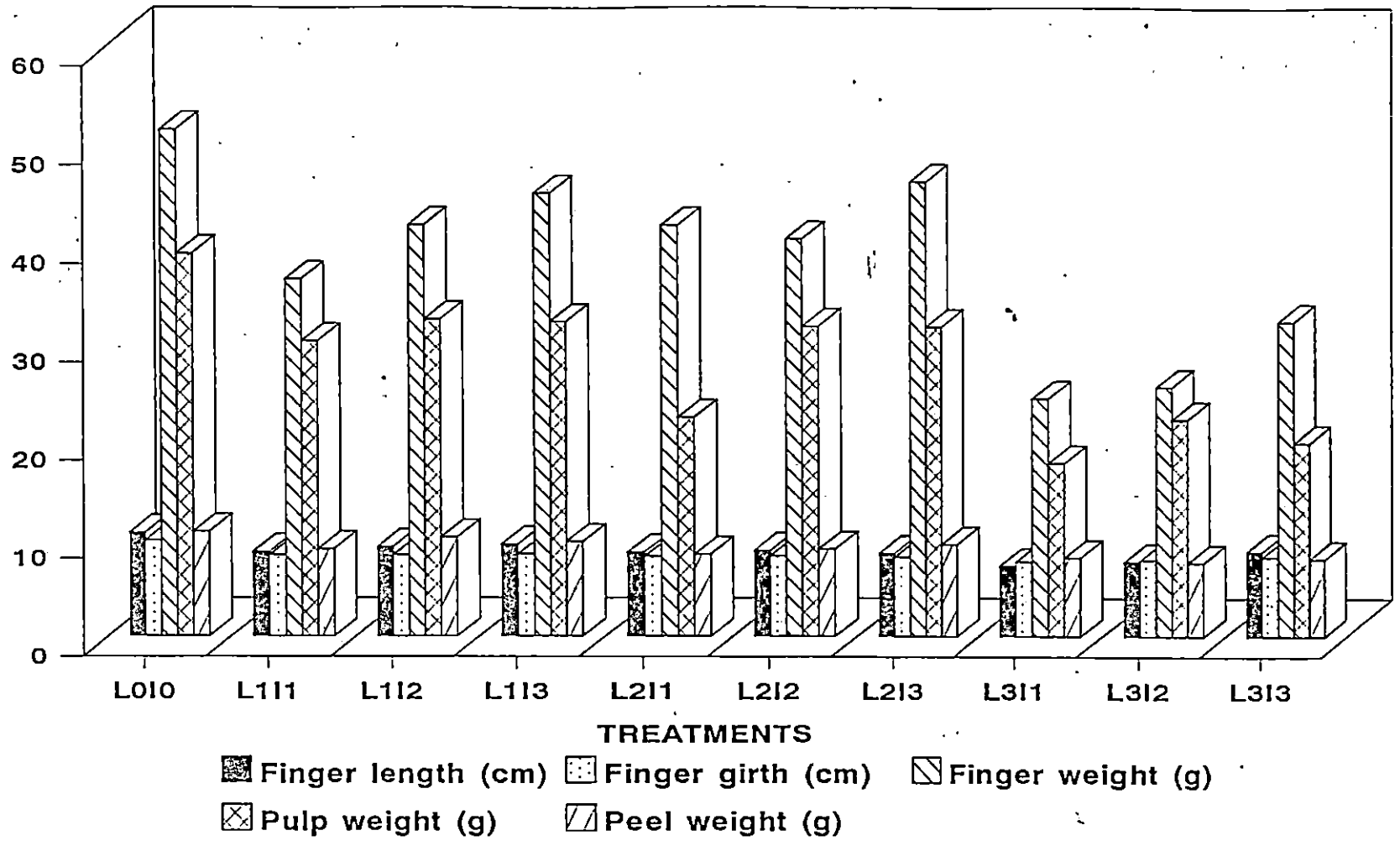


Fig. 7. Effect of leaf pruning on fruit characters of banana cv. Njalipoovan

statistically on par. The lowest pulp/peel ratio was recorded in L_3I_1 (2.19) followed by L_3I_3 (2.38) and L_2I_1 (2.67); the three treatments being statistically on par.

The extent of leaf area pruned had significant influence on the morphological characters of finger viz. finger length, finger girth, finger weight, pulp weight, peel weight and pulp/peel ratio of fruits in 'Njalipoovan'. The highest finger length was recorded in L_1 (9.04 cm) followed by L_2 (8.61 cm) and L_3 (7.84 cm). The three treatments were significantly different from one another. The finger girth was the highest in L_1 (8.29 cm) followed by L_2 (8.15 cm); the two treatments being statistically on par. The lowest finger girth was recorded in L_3 (7.86 cm). The highest finger weight was recorded in L_2 (42.87 g) followed by L_1 (42.10 g) and L_3 (27.29 g). The three treatments were significantly different from one another. The highest pulp weight was recorded in L_1 (31.49 g) followed by L_2 (28.52 g) and L_3 (19.86 g); the three treatments being significantly different from one another. The peel weight of fruits also showed the same trend. The highest peel weight was observed in L_1 (9.52 g) followed by L_2 (8.88 g) and L_3 (7.82 g); the three treatments being significantly different from one another. The pulp/peel ratio was the highest in L_1 (3.31) followed by L_2 (3.21); the two treatments being statistically on par. The lowest pulp/peel ratio was recorded in L_3 (2.50).

The time of leaf pruning significantly influenced the finger length, finger weight and pulp weight in 'Njalipoovan'. The finger girth, peel weight and the pulp/peel ratio were not significantly influenced. The finger length was the highest in the treatment I_3 (8.84 cm) followed by I_2 (8.51 cm); the two treatments being statistically on par. The lowest finger length was recorded in I_1 (8.14 cm). The highest finger weight was recorded in I_3 (41.15 g). This was followed by I_2 (35.95 g) and I_1 (34.17 g). The three treatments were significantly different from one another. The highest pulp weight was recorded in I_2 (28.71 g) followed by I_3 (27.79 g); the two treatments being statistically on par. The lowest pulp weight was recorded in I_1 (23.37 g).

The combined effect of area of lamina removed and the time of pruning did not significantly influence the length and girth of fingers. However, the weight of fingers, pulp weight, peel weight and pulp/peel ratio were highest when the severity of leaf pruning was lesser. Removal of upto 25 to 50 per cent of the lamina 15 or 30 days after unfurling of the leaves suffered lesser reduction in the weight of individual fingers. It was also noted that the single effects of extent of leaf area removed and the time of pruning showed a similar trend. Finger length, girth and weight, pulp weight, peel weight and pulp/peel ratio

were less affected when 25 per cent of the lamina was removed 15 to 30 days after unfurling of the leaves.

In 'Palayankodan', the data on the combined effect of leaf area removed and the time of pruning indicated that there was significant difference in finger length in the different treatments. The finger girth, finger weight, pulp weight, peel weight and pulp /peel ratio of fruits were not significantly altered.

The highest finger length in 'Palayankodan' was recorded in L_0I_0 (11.34 cm) which was statistically on par with L_1I_3 (11.14 cm). The treatment L_2I_3 (10.43 cm) which followed L_1I_3 was statistically on par with L_1I_2 (9.96 cm). L_1I_2 and L_2I_2 were statistically on par. The lowest finger length was observed in L_3I_1 (7.72 cm) followed by L_3I_2 (7.79 cm) and L_3I_3 (8.15 cm); the three treatments being statistically on par.

The extent of leaf area pruned significantly influenced the finger length, finger girth, finger weight, pulp weight, peel weight and pulp/peel ratio of fruits in 'Palayankodan'. The highest finger length was recorded in L_1 (10.09 cm) followed by L_2 (9.68 cm); the two treatments being statistically on par and significantly superior to L_3 (7.89 cm). The finger girth was the highest in L_1 (9.05 cm) followed by L_2 (8.44 cm) and L_3 (8.01 cm). The three treatments were significantly different from one

Table 15 Effect of leaf pruning on the fruit characters of banana cv. Palayankodan

Treatment	Finger length (cm)	Finger girth (cm)	Finger weight (g)	Pulp weight (g)	Peel weight (g)	Pulp/peel ratio
L_0I_0	11.34	10.03	52.82	34.35	11.62	2.96
L_1I_1	9.18	8.26	46.06	28.09	9.39	3.02
L_1I_2	9.96	9.14	48.52	30.37	9.65	3.15
L_1I_3	11.14	9.76	49.95	30.58	10.01	3.06
L_2I_1	9.19	8.05	44.06	23.15	8.49	2.73
L_2I_2	9.42	8.33	46.52	21.55	9.08	2.38
L_2I_3	10.43	8.94	50.08	26.36	8.76	3.02
L_3I_1	7.72	7.45	35.65	18.18	8.17	2.23
L_3I_2	7.79	8.29	35.77	17.17	8.16	2.10
L_3I_3	8.15	8.28	42.83	26.01	8.03	2.49
F-test	*	NS	NS	NS	NS	NS
SE	0.196	0.355	1.308	1.185	0.418	0.180
CD(0.05)	0.5448	-	-	-	-	-
L_1	10.09	9.05	48.17	29.68	9.68	3.08
L_2	9.68	8.44	46.89	23.69	8.78	2.71
L_3	7.89	8.01	38.09	18.46	8.11	2.28
F-test	**	**	**	**	**	**
SE	0.151	0.120	0.396	0.396	0.119	0.086
CD(0.05)	0.4208	0.3343	1.1086	1.0652	0.3300	0.2356
I_1	8.70	7.92	41.93	23.14	8.68	2.66
I_2	9.06	8.59	43.60	23.03	8.96	2.55
I_3	9.91	8.99	47.62	25.65	8.93	2.86
F-test	**	*	*	NS	NS	NS
SE	0.163	0.204	1.167	1.801	0.270	0.191
CD(0.05)	0.4522	0.5654	3.2358	-	-	-

NS - Not significant
* - Significant at 5% level
** - Significant at 1% level

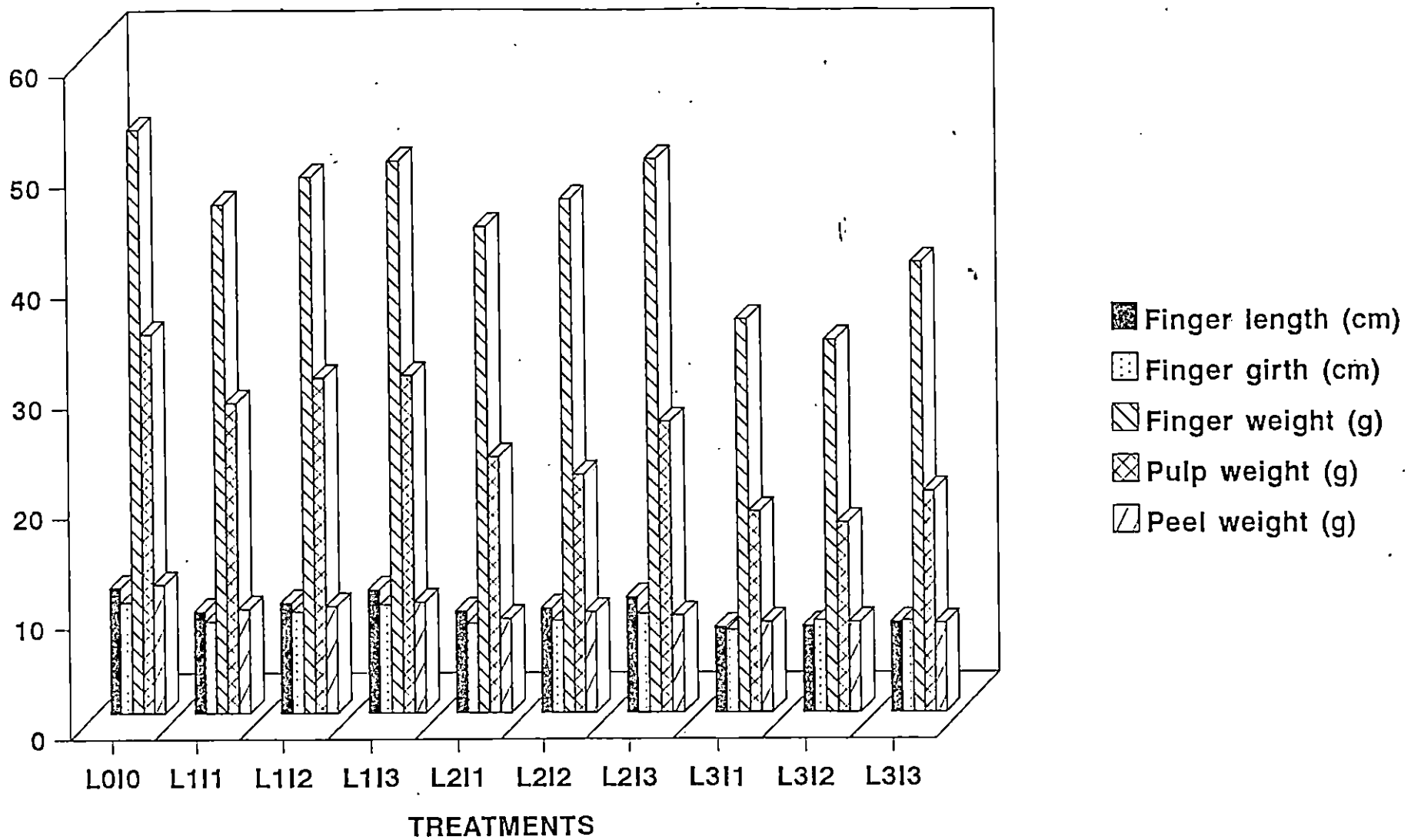


Fig. 8. Effect of leaf pruning on fruit characters of banana cv. Palayankodan

another. The finger weight, pulp/weight, peel weight and pulp/peel ratio showed the same trend. The finger weight was the highest in L_1 (48.17 g), followed by L_2 (46.89 g) and L_3 (38.09 g); the three treatments being significantly different from one another. The pulp weight was the highest in L_1 (29.68 g) followed by L_2 (23.69 g) and L_3 (18.46 g); the three treatments being significantly different from one another. The highest peel weight was observed in L_1 (9.68 g) followed by L_2 (8.78 g) and L_3 (8.11 g). The three treatments were significantly different from one another. The highest pulp/peel ratio was recorded in L_1 (3.08) followed by L_2 (2.71) and L_3 (2.28); the three treatments being significantly different from one another.

The time of leaf pruning significantly influenced the length, girth and weight of fingers in 'Palayankodan'. The peel weight, pulp weight and pulp/peel ratio of the fruits were not significantly affected. The highest finger length was recorded in the treatment I_3 (9.91 cm). This was followed by I_2 (9.06 cm) and I_1 (8.70 cm); the two treatments being statistically on par. The finger girth was the highest in I_3 (8.99 cm) followed by I_2 (8.59 cm). The two treatments were statistically on par and superior to I_1 (7.92 cm). The highest finger weight was recorded in I_3 (47.62 g). This was significantly superior to I_2 (43.60 g) and I_1 (41.93 g) which were statistically on par.

5 Abnormalities in fruit shape and fruit filling of banana cv. Palayankodan.


PALAYANKODAN
L3I1
L3I2

Plate 6 Levels of leaf pruning in banana cv. Palayankodan

L1 = Removal of 25% of total leaf area

L2 = Removal of 50% of total leaf area

L3 = Removal of 75% of total leaf area


L1
L2
L3

Abnormalities in fruit shape and filling of fruits were observed in 'Palayankodan' under the influence of the leaf pruning treatments (Plate 5). Fruits from plants in L_3I_1 and L_3I_2 showed such abnormalities more explicitly. In L_3I_1, the severest pruning intensity imposed, the fingers in the upper hand were highly malformed in shape, reduced in size and fruit filling was extremely reduced. The treatment L_3I_2 also produced fruits with poor filling and prominent ridges. Thus the results indicated that fruit shape and filling are also influenced by removal of 75 per cent lamina prior to 15 days of unfurling.

The combined effect of leaf area removed and the time of pruning was not found to significantly influence the fruit characters in 'Palayankodan' except in case of finger length. Length of fingers was significantly reduced by removal of 75 per cent of the lamina at all the stages of removal. The retardation was the least when 25 per cent of the lamina was removed 30 days after unfurling. The single effect of the extent of lamina pruned had a strong influence on the fruit characters. Removal of 25 to 50 per cent of the leaf area resulted in comparatively lesser reduction in fruit size. The time of removal of leaves also had a marked effect on length, girth and weight of fingers. Pruning after 30 days of unfurling of leaves had less deleterious effect on the above characters.

The above results thus showed that leaf pruning to the extent of 25 per cent of the lamina 30 days after unfurling of leaves had comparatively less harmful effect on the fruit size of 'Njalipoovan' and 'Palayankodan'. The pruning intensities of removal of upto 50 per cent lamina 15 days after unfurling had lesser deleterious effect than more severe pruning.

4.3 Effect of leaf pruning on fruit quality of banana cvs. Njalipoovan and Palayankodan

The results of the study on the fruit quality of cv. Njalipoovan are presented in Table 16 and Fig. 9 and the results of the study on cv. Palayankodan are presented in Table 17 and Fig. 10.

In 'Njalipoovan', the combined effect of area of lamina pruned and the time of pruning had significant influence only on TSS content of the fruits. The acidity, total sugar content, reducing sugar content, non-reducing sugar content, sugar/acid ratio, total carbohydrate content and the green life of fruits were not significantly influenced. In 'Njalipoovan', the treatment L_1I_3 (26.50 per cent) recorded the highest mean TSS content followed by L_0I_0 (25.75 per cent), L_1I_1 (24.83 per cent), L_3I_2 (24.58 per cent), L_2I_3 (24.42 per cent) and L_3I_1 (24.33 per cent); the six treatments being statistically on par. The lowest

Table 16 Effect of leaf pruning on the fruit quality of banana cv. Njalipoovan

Treatment	Acidity (%)	TSS (%)	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)	Sugar/Acid ratio	Total carbohydrate (%)	Green life of fruits (days)
L_0I_0	0.46	25.75	16.89	14.86	2.03	36.75	86.67	5.92
L_1I_1	0.44	22.83	14.58	13.11	1.46	33.21	81.97	6.00
L_1I_2	0.45	22.83	16.18	14.30	1.88	35.99	85.41	5.67
L_1I_3	0.47	26.50	17.76	15.83	1.92	38.10	88.31	5.67
L_2I_1	0.42	22.75	13.13	12.36	0.77	31.63	79.35	4.83
L_2I_2	0.40	23.67	15.06	13.53	1.53	37.65	83.10	5.33
L_2I_3	0.38	24.42	16.14	14.26	1.88	43.15	85.30	5.83
L_3I_1	0.40	24.33	12.42	12.04	0.38	31.02	77.89	4.42
L_3I_2	0.40	24.58	12.23	11.66	0.57	30.57	77.43	4.17
L_3I_3	0.43	22.00	14.44	13.98	1.46	36.14	83.91	4.67
F-test	NS	*	NS	NS	NS	NS	NS	NS
SE	0.026	0.874	0.590	0.668	0.355	1.631	1.254	0.367
CD(0.05)	-	2.4271	-	-	-	-	-	-
L_1	0.45	24.72	16.17	14.41	1.76	35.77	85.23	5.78
L_2	0.40	23.61	14.78	13.38	1.39	37.48	82.58	5.33
L_3	0.41	23.64	13.36	12.56	0.80	32.57	79.74	4.42
F-test	NS	NS	*	NS	*	NS	*	*
SE	0.020	0.677	0.731	0.699	0.215	2.125	1.275	0.232
CD(0.05)	-	-	2.028	-	0.596	-	3.542	0.6436
I_1	0.42	23.97	13.37	12.50	0.87	31.95	79.74	5.08
I_2	0.41	23.69	14.49	13.16	1.32	34.74	81.98	5.05
I_3	0.42	24.31	16.45	14.69	1.75	39.13	85.84	5.39
F-test	NS	NS	*	**	NS	**	*	NS
SE	0.010	0.170	0.594	0.329	0.284	1.005	1.218	0.352
CD(0.05)	-	-	1.650	0.913	-	2.793	3.377	-

NS - Not significant
* - Significant at 5% level
** - Significant at 1% level

TSS content was recorded in L_3I_3 (22.00 per cent). L_3I_3 was statistically on par with L_2I_1 (22.75 per cent), L_1I_2 (22.83 per cent), L_2I_2 (23.67 per cent) and L_3I_1.

The extent of leaf area pruned significantly altered the total sugar content, non-reducing sugar content, total carbohydrate content and the green life of fruits in 'Njalipoovan'. The highest total sugar content was recorded in L_1 (16.17 per cent) followed by L_2 (14.78 per cent); the two treatments being statistically on par. The lowest total sugar content was recorded in L_3 (13.36 per cent) and this was statistically on par with L_2. The non-reducing sugar content was the highest in L_1 (1.76 per cent) followed by L_2 (1.39 per cent); the two treatments being statistically on par. The lowest non-reducing sugar content was recorded in L_3 (0.80 per cent) which was statistically on par with L_2. The total carbohydrate content was the highest in L_1 (85.23 per cent) followed by L_2 (82.58 per cent); the two treatments being statistically on par. The lowest total carbohydrate content was recorded in L_3 (79.74 per cent). L_2 and L_3 were statistically on par. The green life of fruits was the highest in L_1 (5.78 days) followed by L_2 (5.33 days); the two treatments being statistically on par. The lowest green life of fruits was recorded in L_3 (4.42 days) and this was significantly inferior to the other treatments.

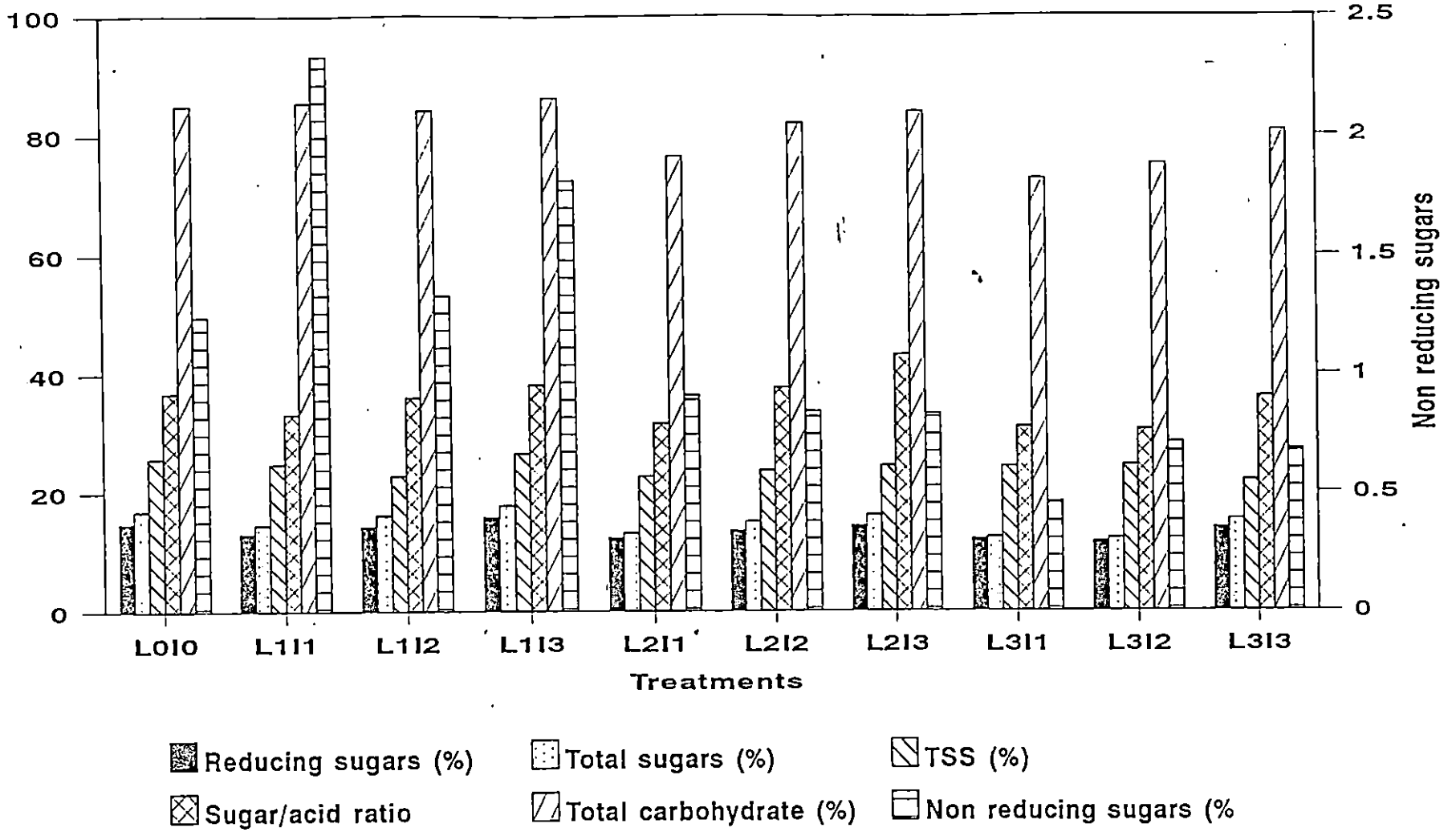


Fig. 9. Effect of leaf pruning on fruit quality of banana cv. Njalipoovan

The time of leaf pruning significantly influenced the total sugar content, the reducing sugar content, the sugar/acid ratio and the total carbohydrate content of the fruits in 'Njalipoovan'. The highest total sugar content was recorded in I_3 (16.45 per cent). This was followed by I_2 (14.49 per cent) and I_1 (13.37 per cent); the two treatments being statistically on par. The reducing sugar content of the fruits was highest in I_3 (14.69 per cent). This was followed by I_2 (13.16 per cent) and I_1 (12.50 per cent) which were statistically on par. The sugar/acid ratio of the fruits was the highest in I_3 (39.13 per cent). This was followed by I_2 (34.74 per cent) and I_1 (31.95 per cent) which were statistically on par. The total carbohydrate content of the fruits was the highest in I_3 (85.84 per cent). This was followed by I_2 (81.98 per cent) and I_1 (79.74 per cent), the two treatments being statistically on par.

The results thus indicated that the fruit quality was not significantly affected by the leaf pruning treatments in 'Njalipoovan'. However, the individual effect of the extent of leaf area removed revealed that removal of 25 to 50 per cent of the leaf area had comparatively less harmful effect on quality of fruits. Similarly removal of leaves after 30 days of unfurling had less deleterious effect on the quality of fruits in 'Njalipoovan'.

The data on the combined effect of leaf area removed and the interval of pruning in 'Palayankodan' indicated that there was significant difference in acidity, TSS content, total sugar content, reducing sugar content, sugar/acid ratio and the total carbohydrate content of the fruits. The non-reducing sugar content and the green life of the fruits were not significantly altered.

The acidity of the fruits was the highest in the treatment L_2I_1 (0.530 per cent) followed by L_1I_2 (0.507 per cent), L_1I_3 (0.50 per cent) and L_2I_3 (0.490 per cent); the four treatments being statistically on par. The lowest acidity was recorded in L_3I_3 (0.413 per cent) followed by L_2I_2 (0.453 per cent), L_3I_1 (0.457 per cent) and L_1I_1 (0.457 per cent); the four treatments being statistically on par.

The highest TSS content of the fruits was recorded in L_1I_2 (25.67 per cent) followed by L_2I_2 (25.58 per cent), L_2I_1 (25.50 per cent), L_0I_0 (25.33 per cent), L_3I_3 (24.92 per cent), L_3I_1 (24.83 per cent) and L_1I_1 (23 per cent). These six treatments were statistically on par. The lowest TSS content was recorded in L_1I_3 (22 per cent) followed by L_2I_3 (22.25 per cent) and L_3I_2 (22.42 per cent). L_1I_3, L_2I_3, L_3I_2 and L_1I_1 were statistically on par.

Table 17 Effect of leaf pruning on the fruit quality of banana cv. Palayankodan

Treatment	Acidity (%)	TSS (%)	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)	Sugar/Acid ratio	Total carbohydrate (%)	Green life of fruits (days)
L_0I_0	0.473	25.33	17.01	16.10	1.24	35.98	84.93	5.58
L_1I_1	0.457	23.00	17.15	15.15	2.33	37.72	85.37	5.25
L_1I_2	0.507	25.67	16.70	15.04	1.33	33.06	84.18	5.75
L_1I_3	0.500	22.00	17.54	15.74	1.81	35.18	86.27	6.50
L_2I_1	0.530	25.50	12.76	12.66	0.91	23.89	76.52	6.17
L_2I_2	0.453	25.58	15.44	14.60	0.84	34.22	82.07	6.25
L_2I_3	0.490	22.25	16.62	15.79	0.83	33.94	84.02	5.75
L_3I_1	0.457	24.83	11.28	10.95	0.46	24.69	72.74	4.50
L_3I_2	0.473	22.42	12.10	11.38	0.71	25.64	75.26	4.67
L_3I_3	0.413	24.92	14.75	14.07	0.68	35.81	80.76	5.25
F-test	*	*	*	*	NS	**	*	NS
SE	0.018	1.016	0.548	0.494	0.324	1.798	1.266	0.384
CD(0.05)	0.0509	2.8206	1.5229	1.3658	-	4.9905	2.9596	-
L_1	0.48	23.56	17.13	15.31	1.82	35.32	85.27	5.83
L_2	0.49	24.44	14.91	14.38	0.86	30.68	80.87	6.06
L_3	0.45	24.06	12.71	12.13	0.62	28.71	76.25	4.81
F-test	NS	NS	**	**	**	**	**	*
SE	0.016	1.091	0.612	0.517	0.182	0.510	1.080	0.266
CD(0.05)	-	-	1.7132	1.4349	0.5044	1.4166	3.0929	0.7383
I_1	0.48	24.44	13.70	12.95	1.23	28.77	78.21	5.31
I_2	0.48	24.55	14.75	13.68	0.96	30.97	80.50	5.56
I_3	0.47	23.06	16.30	15.20	1.11	34.98	83.68	5.83
F-test	NS	NS	*	NS	NS	NS	*	NS
SE	0.021	0.486	0.532	0.767	0.318	1.877	1.230	0.303
CD(0.05)	-	-	1.4791	-	-	-	3.4127	-

NS - Not significant
* - Significant at 5% level
** - Significant at 1% level

The total sugar content of the fruits in 'Palayankodan' was the highest in L_1I_3 (17.54 per cent) followed by L_1I_1 (17.15 per cent), L_0I_0 (17.01 per cent), L_1I_2 (16.70 per cent) and L_2I_3 (16.62 per cent). The five treatments were statistically on par. The lowest total sugar content was observed in L_3I_1 (11.28 per cent) followed by L_3I_2 (12.10 per cent) and L_2I_1 (12.66 per cent); the three treatments being statistically on par.

The reducing sugar content of the fruits was the highest in L_0I_0 (16.10 per cent). This was followed by L_2I_3 (15.79 per cent), L_1I_3 (15.74 per cent), L_1I_1 (15.15 per cent) and L_1I_2 (15.04 per cent). The five treatments were statistically on par. The lowest reducing sugar content was observed in L_3I_1 (10.95 per cent) followed by L_3I_2 (11.38 per cent) and L_2I_1 (12.76 per cent); the three treatments being statistically on par.

The sugar/acid ratio of the fruits was the highest in L_1I_1 (37.72). L_1I_1 was statistically on par with L_0I_0 (35.98), L_3I_3 (35.81), L_1I_3 (35.18), L_2I_2 (34.22), L_2I_3 (33.94) and L_1I_2 (33.06). The lowest sugar/acid ratio was recorded in L_2I_1 (23.89) followed by L_3I_1 (24.69) and L_3I_2 (25.64), the three treatments being statistically on par.

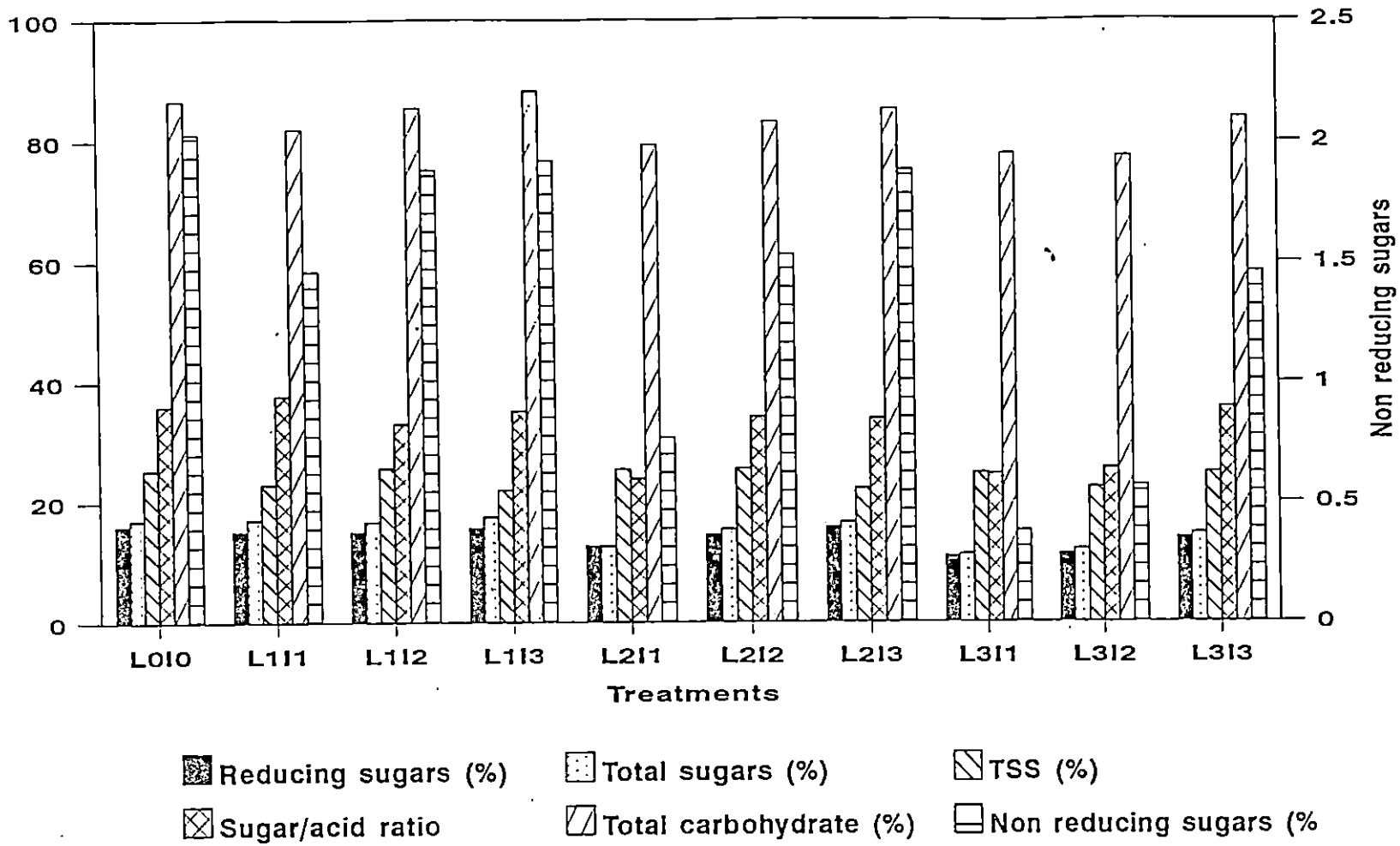


Fig. 10. Effect of leaf pruning on fruit quality of banana cv. Palayankodan

The highest total carbohydrate content of the fruits was observed in L_1I_3 (86.27 per cent). This was followed by L_1I_1 (85.37 per cent), L_0I_0 (84.93 per cent), L_1I_2 (84.18 per cent) and L_2I_3 (84.02 per cent). The lowest total carbohydrate content was recorded in L_3I_1 (72.74 per cent). L_3I_1 was statistically on par with L_3I_2 (75.26 per cent). L_3I_2 and L_2I_1 (76.52 per cent) were statistically on par.

The extent of leaf area pruned significantly influenced the total sugar content, reducing sugar content, non-reducing sugar content, sugar/acid ratio, total carbohydrate content and the green life of fruits in 'Palayankodan'. The acidity and TSS content of the fruits were not significantly altered. The highest total sugar content was recorded in L_1 (17.13 per cent) followed by L_2 (14.91 per cent) and L_3 (12.71 per cent). The three treatments differed significantly from one another. The reducing sugar content of the fruits was the highest in L_1 (15.31 per cent) followed by L_2 (14.38 per cent); the two treatments being statistically on par. The lowest value was recorded in L_3 (12.13 per cent). The non-reducing sugar content of the fruits was the highest in L_1 (1.82 per cent). This was followed by L_2 (0.86 per cent) and L_3 (0.62 per cent); the two treatments being statistically on par. The sugar/acid ratio of the fruits was the

highest in L_1 (35.32) followed by L_2 (30.68) and L_3 (28.71). The three treatments were significantly different from one another. The total carbohydrate content of the fruits was the highest in L_1 (85.27 per cent) followed by L_2 (80.87 per cent) and L_3 (76.25 per cent). The three treatments were significantly different from one another. The green life of the fruits was the highest in L_2 (6.06 days) followed by L_1 (5.83 days). The treatments L_1 and L_2 were statistically on par and significantly superior to L_3 (4.81 days).

The time of leaf pruning significantly influenced the total sugar content and the total carbohydrate content of the fruits of 'Palayankodan'. The highest total sugar content of the fruits was recorded in I_3 (16.30 per cent). This was followed by I_2 (14.75 per cent) and I_1 (13.70 per cent); the two treatments being statistically on par. The highest total carbohydrate content of the fruits was recorded in I_3 (83.68 per cent) followed by I_2 (80.50 per cent); the two treatments being statistically on par. The lowest value was recorded in I_1 (78.21 per cent). I_2 and I_1 were statistically on par. The acidity, TSS content, reducing sugar content, non-reducing sugar content, sugar/acid ratio and the green life of the fruits were not significantly influenced by the time of leaf pruning in 'Palayankodan'.

The above results indicated that the combined effect of area of lamina removed and the time of pruning had a marked influence on the quality of fruits in 'Palayankodan'. In general it can be assumed that removal of lamina earlier to 15 days of unfurling impaired the fruit quality to a greater extent compared to more severe leaf pruning. Removal of more than 50 per cent of leaf area was detrimental to quality of fruits.

The individual effect of the area of lamina removed was more pronounced than the time of removal. Removal of less than 50 per cent leaf area was more beneficial to maintain satisfactory quality. Retention of leaves upto 30 days after unfurling was desirable to maintain the fruit quality.

Comparing the response to leaf pruning it was observed that the cv. Palayankodan was more prone to the ill effects of severe leaf pruning than 'Njalipoovan'. In general, it was observed that retention at least 50 per cent of the leaf area for a period of 15 to 30 days after unfurling was a comparatively safe level of pruning from the point of view of fruit quality in 'Palayankodan'.

4.4 Effect of leaf pruning on the nutrient content in banana cvs. Njalipoovan and Palayankodan

Results of the study on the cv. Njalipoovan are given in Table 18 and on the cv. Palayankodan are given in Table 19.

Table 18 Effect of leaf pruning on the nutrient content of banana cv. Njalipoovan

Treatment	Nutrient content (% dry weight)														
	Corm			Pseudostem			Leaf			Leaf sheath			Fruit		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
L_0I_0	1.543	0.092	5.960	1.213	0.098	4.723	1.684	0.332	3.335	1.207	0.878	4.833	0.922	0.335	1.945
L_1I_1	1.827	0.078	5.798	0.691	0.090	4.267	1.194	0.286	3.028	1.104	0.766	4.102	0.796	0.242	1.650
L_1I_2	1.278	0.082	5.688	1.060	0.094	4.578	1.263	0.327	3.126	1.180	0.776	4.360	0.860	0.264	1.843
L_1I_3	1.500	0.087	5.872	1.090	0.095	4.605	1.505	0.332	3.227	1.360	0.799	4.681	0.868	0.298	1.865
L_2I_1	0.985	0.066	4.761	0.705	0.079	3.881	0.934	0.236	2.576	0.833	0.651	3.815	0.699	0.144	1.650
L_2I_2	1.164	0.069	5.263	0.824	0.085	4.174	1.156	0.259	2.970	0.898	0.666	4.256	0.705	0.171	1.625
L_2I_3	1.370	0.071	5.402	0.837	0.088	4.391	1.153	0.283	3.068	0.933	0.735	4.460	0.743	0.236	1.730
L_3I_1	0.786	0.057	4.586	0.675	0.071	3.375	0.812	0.158	2.403	0.646	0.585	3.345	0.760	0.142	1.449
L_3I_2	0.817	0.059	4.680	0.785	0.075	3.539	0.913	0.177	2.654	0.755	0.643	3.401	0.644	0.147	1.514
L_3I_3	0.821	0.066	4.798	0.734	0.077	3.695	0.914	0.236	2.578	0.753	0.661	3.900	0.663	0.130	1.332
F-test	NS	NS	NS	*	NS	NS	NS	*	NS	NS	NS	NS	NS	*	NS
SE	-	-	-	57.28	0.003	0.130	0.077	0.007	0.202	0.062	0.030	0.191	0.032	0.020	0.074
CD(0.05)	-	-	-	0.1590	-	-	-	0.0204	-	-	-	-	-	0.0204	-
L_1	1.320	0.082	5.786	0.947	0.093	4.483	1.320	0.315	3.127	1.215	0.780	4.381	0.841	0.268	1.786
L_2	1.173	0.069	5.142	0.789	0.084	4.149	1.081	0.259	2.871	0.888	0.684	4.177	0.716	0.183	1.668
L_3	0.808	0.061	4.688	0.731	0.074	3.536	0.880	0.190	2.545	0.718	0.629	3.549	0.656	0.140	1.498
F-test	**	**	**	*	**	*	**	**	**	**	**	**	*	**	**
SE	-	-	-	0.038	0.001	0.175	0.045	0.002	0.072	0.052	0.025	0.107	0.032	0.016	0.038
CD(0.05)	0.1360	0.0084	0.4959	0.1054	0.0029	0.4851	0.1267	0.0063	0.2015	0.1427	0.0682	0.2984	0.0880	0.0439	0.1046
I_1	0.985	0.067	5.048	0.691	0.080	3.841	0.980	0.227	2.669	0.861	0.667	3.754	0.718	0.176	1.583
I_2	1.087	0.070	5.210	0.889	0.085	4.097	1.111	0.254	2.917	0.944	0.695	4.005	0.736	0.194	1.660
I_3	1.230	0.075	5.358	0.887	0.087	4.230	1.191	0.284	2.958	1.016	0.731	4.347	0.758	0.221	1.709
F-test	*	*	**	*	NS	*	**	**	**	*	**	NS	NS	**	*
SE	-	-	-	0.048	0.002	0.076	0.036	0.005	0.034	0.032	0.008	0.195	0.014	0.018	0.033
CD(0.05)	0.1181	0.0046	0.1289	0.1317	-	0.2106	0.0965	0.0139	0.0930	0.0855	0.0218	-	-	0.0150	0.0914

NS - Not significant * Significant at 5% level ** Significant at 1% level

The data on the combined effect of leaf area removed and the interval of pruning indicated that in 'Njalipoovan', there was significant difference in the nitrogen content of the pseudostem, phosphorus content of the leaf and phosphorus content of the fruits among the treatments.

Among the treated plants, the nitrogen content of the pseudostem was the highest in L_0I_0 (1.213 per cent). This was followed by L_1I_3 (1.090 per cent) and L_1I_2 (1.060 per cent); the two treatments being statistically on par. The lowest nitrogen content was recorded in L_3I_1 (0.675 per cent) followed by L_1I_1 (0.691 per cent), L_2I_1 (0.705 per cent), L_3I_3 (0.734 per cent), L_3I_2 (0.785 per cent) and L_2I_2 (0.824 per cent); the six treatments being statistically on par.

The phosphorus content of the leaf was the highest in L_0I_0 (0.332 per cent), L_1I_3 (0.332 per cent) followed by L_1I_2 (0.327 per cent); the three treatments being statistically on par. The lowest phosphorus content was recorded in L_3I_1 (0.158 per cent) followed by L_3I_2 (0.177 per cent) and L_3I_3 (0.236 per cent); the former two treatments being statistically on par.

The phosphorus content of the fruits was the highest in L_0I_0 (0.335 per cent) followed by L_1I_3 (0.298 per cent). This was followed by L_1I_2 (0.264 per cent) and L_1I_1 (0.242 per cent). The four treatments differed significantly from one another. The lowest phosphorus content in fruits was recorded in L_3I_3 (0.130

per cent) followed by L_3I_1 (0.142 per cent), L_2I_1 (0.144 per cent) and L_3I_2 (0.147 per cent); the four treatments being statistically on par.

The extent of leaf area pruned significantly influenced the nutrient content of the plant parts in 'Njalipoovan'. The nitrogen content of the corm was the highest in L_1 (1.320 per cent) followed by L_2 (1.173 per cent). The lowest nitrogen content was recorded in L_3 (0.808 per cent). The three values were significantly different from one another. The phosphorus content of the corm was the highest in L_1 (0.082 per cent). This was followed by L_2 (0.069 per cent) and L_3 (0.061 per cent); the two treatments being statistically on par. The potassium content of the corms was the highest in L_1 (5.786 per cent) followed by L_2 (5.142 per cent) and L_3 (4.688 per cent); the latter two treatments being statistically on par.

The highest nitrogen content of the pseudostem was recorded in L_1 (0.947 per cent). This was followed by L_2 (0.789 per cent) and L_3 (0.731 per cent); the two treatments being statistically on par.

The phosphorus content of the pseudostem was the highest in L_1 (0.093 per cent) followed by L_2 (0.084 per cent) and L_3 (0.074 per cent). The three treatments were significantly different from one another. The potassium content of the

pseudostem was the highest in L_1 (4.483 per cent) followed by L_2 (4.149 per cent); the two treatments being statistically on par. The lowest potassium content was recorded in L_3 (3.536 per cent).

The nitrogen content of the leaf was the highest in L_1 (1.320 per cent) followed by L_2 (1.081 per cent). The lowest nitrogen content was recorded in L_3 (0.880 per cent). The three treatments were significantly different from one another. The phosphorus content of the leaves was the highest in L_1 (0.315 per cent) followed by L_2 (0.259 per cent) and L_3 (0.190 per cent). The three treatments were significantly different from one another. The potassium content of the leaves was the highest in L_1 (3.127 per cent) followed by L_2 (2.871 per cent) and L_3 (2.545 per cent). The three treatments differed significantly from one another.

The nitrogen content of the leaf sheath was the highest in L_1 (1.215 per cent). This was followed by L_2 (0.888 per cent) and L_3 (0.718 per cent). The three treatments significantly differed from one another. The phosphorus content of the leaf sheath was the highest in L_1 (0.780 per cent). This was followed by L_2 (0.684 per cent) and L_3 (0.629 per cent) which were statistically on par. The potassium content of the leaf sheath was the highest in L_1 (4.381 per cent) followed by L_2 (4.177 per cent); the two treatments being statistically on par. The lowest K content of the leaf sheath was recorded in L_3 (3.549 per cent).

The nitrogen content of the fruits was the highest in L_1 (0.841 per cent). This was followed by L_2 (0.716 per cent) and L_3 (0.656 per cent) which were statistically on par. The phosphorus content of the fruits was the highest in L_1 (0.268 per cent). This was followed by L_2 (0.183 per cent) and L_3 (0.140 per cent); the two treatments being statistically on par. The potassium content of the fruits was the highest in L_1 (1.786 per cent) followed by L_2 (1.668 per cent) and L_3 (1.498) per cent). The three treatments were significantly different from one another.

The time of leaf pruning significantly influenced the nutrient content of the various plant parts except the phosphorus content of pseudostem, potassium content of leaf sheath and nitrogen content of the fruits.

The highest nitrogen content of the corm was recorded in I_3 (1.230 per cent). This was followed by I_2 (1.087 per cent) and I_1 (0.985 per cent); the two treatments being statistically on par. The phosphorus content of the corm was the highest in I_3 (0.075 per cent) followed by I_2 (0.070 per cent); the two treatments being statistically on par. The lowest phosphorus content of corms was recorded in I_1 (0.067 per cent). I_1 and I_2 were statistically on par. The potassium content of the corms was the highest in I_3 (5.358 per cent) followed by I_2 (5.210 per cent) and I_1 (5.048 per cent). The three treatments were

significantly different from one another. The nitrogen content of the pseudostem was the highest in I_2 (0.889 per cent) followed by I_3 (0.887 per cent); the two treatments being statistically on par. This was followed by I_1 (0.691 per cent). The potassium content of the pseudostem was the highest in I_3 (4.23 per cent) followed by I_2 (4.097 per cent); the two treatments being statistically on par. The lowest potassium content of pseudostem was recorded in I_1 (3.841 per cent).

The nitrogen content of the leaves was the highest in I_3 (1.191 per cent) followed by I_2 (1.111 per cent); the two treatments being statistically on par. The lowest nitrogen content of leaves was recorded in I_1 (0.980 per cent). The phosphorus content of the leaves was the highest in I_3 (0.284 per cent) followed by I_2 (0.254 per cent) and I_1 (0.227 per cent). The three treatments differed significantly from one another. The potassium content of the leaves was the highest in I_3 (2.958 per cent) followed by I_2 (2.917 per cent); the two treatments being statistically on par. The lowest potassium content of leaves was recorded in I_1 (2.669 per cent).

The nitrogen content of the leaf sheath was the highest in I_3 (1.016 per cent). This was followed by I_2 (0.944 per cent) and I_1 (0.861 per cent). The former two treatments were statistically on par and so were the latter two. The phosphorus

content of the leaf sheath was the highest in I_3 (0.731 per cent). This was followed by I_2 (0.695 per cent) and I_1 (0.667 per cent). The three treatments were significantly different from one another.

The phosphorus content of the fruits was the highest in I_3 (0.221 per cent) followed by I_2 (0.194 per cent) and I_1 (0.176 per cent). The three treatments were significantly different from one another. The potassium content of the fruits was the highest in I_3 (1.709 per cent) followed by I_2 (1.660 per cent); the two treatments being statistically on par. The lowest value was recorded in I_1 (1.583 per cent) which was statistically on par with I_2.

The above results indicated that the combined effect of the time of pruning and the area of lamina removed had significant influence only on the nitrogen content of corms and the phosphorus content of leaf and fruits. In other plant parts, the treatments did not show significant difference in the tissue nutrient status.

The extent of leaf area removed showed a marked influence on the content of major nutrient elements in various plant parts. It was observed that among the different pruning levels, removal of 25 per cent of the lamina resulted in a lesser

extent of reduction in the tissue content of major nutrients followed by removal of 50 per cent of the lamina.

In general, the time of pruning of leaves also exerted an influence on the tissue content of major nutrients in various plant parts. The extent of reduction of the tissue nutrient contents in general was more with higher intensities of pruning. The adverse effects were lesser when the leaves were pruned after 30 days of unfurling followed by 15 days after unfurling.

The data on the combined effect of leaf area removed and the interval of pruning indicated that in 'Palayankodan' there was significant difference only in the nitrogen content of the leaf and potassium content of the leaf sheath. The nutrient content of the other plant parts were not significantly altered.

Among the treated plants, the highest nitrogen content of the leaf was recorded in L_0I_0 (1.404 per cent) and this was significantly superior to all the other treatments. L_1I_3 (1.387 per cent) was significantly superior to all other treatments except L_0I_0. This was followed by L_1I_2 (1.301 per cent) and L_2I_3 (1.262 per cent); the two treatments being statistically on par. The lowest nitrogen content of leaves was recorded in L_3I_1 (0.823 per cent) followed by L_2I_1 (0.832 per cent) and L_3I_2 (0.858 per cent); the three treatments being statistically on par.

Table 19 Effect of leaf pruning on the nutrient content of banana cv. Palayankodan

Treatment	Nutrient content (% dry weight)														
	Corm			Pseudostem			Leaf			Leaf sheath			Fruit		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
L_0I_0	1.228	0.118	4.708	0.952	0.104	4.976	1.404	0.199	3.051	0.999	0.764	3.892	1.117	0.167	1.810
L_1I_1	1.029	0.084	4.262	0.675	0.083	4.380	1.022	0.165	2.608	0.728	0.651	2.503	0.743	0.144	1.585
L_1I_2	1.146	0.094	4.306	0.842	0.093	4.736	1.301	0.181	2.642	0.904	0.727	3.699	0.939	0.160	1.736
L_1I_3	1.172	0.109	4.447	0.881	0.098	4.785	1.387	0.197	2.784	0.997	0.725	3.839	0.978	0.160	1.739
L_2I_1	0.736	0.063	3.774	0.428	0.075	3.715	0.832	0.158	2.569	0.687	0.575	2.169	0.746	0.096	1.304
L_2I_2	1.037	0.087	4.293	0.709	0.084	4.446	1.088	0.164	2.573	0.851	0.683	2.606	0.809	0.157	1.658
L_2I_3	1.131	0.094	4.355	0.731	0.093	4.486	1.262	0.174	2.539	0.875	0.695	3.673	0.870	0.154	1.695
L_3I_1	0.709	0.061	3.139	0.409	0.074	3.489	0.823	0.154	1.861	0.676	0.515	1.981	0.719	0.090	1.185
L_3I_2	0.777	0.068	3.601	0.472	0.079	3.739	0.858	0.160	1.924	0.695	0.605	2.365	0.780	0.100	1.416
L_3I_3	0.850	0.074	3.980	0.473	0.080	4.357	0.937	0.160	2.458	0.716	0.580	2.646	0.783	0.105	1.534
F-test	NS	NS	NS	NS	NS	NS	**	NS	NS	NS	NS	**	NS	NS	NS
SE	0.108	0.008	0.184	0.062	0.004	0.152	0.019	0.007	0.159	0.052	0.039	0.125	0.063	0.013	0.072
CD(0.05)	-	-	-	-	-	-	0.0536	-	-	-	-	0.3467	-	-	-
L_1	1.116	0.096	4.339	0.799	0.091	4.634	1.237	0.181	2.678	0.876	0.701	3.347	0.887	0.155	1.687
L_2	0.968	0.081	4.141	0.623	0.084	4.216	1.061	0.166	2.561	0.804	0.651	2.816	0.808	0.136	1.552
L_3	0.779	0.067	3.573	0.451	0.077	3.862	0.873	0.158	2.081	0.696	0.567	2.331	0.761	0.098	1.378
F-test	**	**	*	**	**	**	**	**	NS	*	**	**	*	**	*
SE	0.040	0.003	0.138	0.054	0.002	0.128	0.043	0.002	0.196	0.046	0.022	0.087	0.023	0.008	0.054
CD(0.05)	0.1102	0.0069	0.3833	0.1494	0.0057	0.3540	0.1188	0.0063	-	0.1264	0.0603	0.2425	0.0648	0.0229	0.1501
I_1	0.824	0.069	3.725	0.504	0.078	3.861	0.892	0.159	2.346	0.697	0.580	2.218	0.736	0.110	1.358
I_2	0.987	0.083	4.067	0.674	0.085	4.307	1.082	0.169	2.380	0.817	0.672	2.890	0.843	0.139	1.603
I_3	1.051	0.092	4.261	0.695	0.090	4.543	1.195	0.177	2.594	0.863	0.667	3.386	0.877	0.140	1.656
F-test	**	NS	**	**	**	*	**	*	*	*	NS	**	**	*	*
SE	0.028	0.008	0.090	0.032	0.002	0.143	0.031	0.003	0.054	0.034	0.029	0.076	0.023	0.006	0.081
CD(0.05)	0.0775	-	0.2502	0.0897	0.0059	0.3984	0.0863	0.0091	0.1509	0.0944	-	0.2109	0.0648	0.0164	0.2151

NS - Not significant * Significant at 5% level ** Significant at 1% level

The potassium content of the leaf sheath was the highest in L_0I_0 (3.892 per cent) followed by L_1I_3 (3.839 per cent), L_1I_2 (3.699 per cent) and L_2I_3 (3.673 per cent); the four treatments being statistically on par. The lowest potassium content of the leaf sheath was recorded in L_3I_1 (1.981 per cent) followed by L_2I_1 (2.169 per cent); the two treatments being statistically on par. L_2I_1 was statistically on par with L_3I_2 (2.365 per cent) and L_1I_1 (2.503 per cent).

The extent of leaf area pruned in 'Palayankodan', significantly influenced the nutrient content of the plant parts. The highest nitrogen content of the corms was recorded in L_1 (1.116 per cent) followed by L_2 (0.968 per cent) and L_3 (0.779 per cent). The three treatments were significantly different from one another.

The phosphorous content of the corms was the highest in L_1 (0.096 per cent) followed by L_2 (0.081 per cent) and L_3 (0.067 per cent). The three treatments were significantly different from one another. The potassium content of the corms was the highest in L_1 (4.339 per cent) followed by L_2 (4.141 per cent); the two treatments being statistically on par. The lowest potassium content of corms was recorded in L_3 (3.573 per cent).

The nitrogen content of the pseudostem was the highest in L_1 (0.799 per cent) followed by L_2 (0.623 per cent) and L_3

(0.451 per cent). The three treatments were significantly different from one another. The phosphorus content of the pseudostem was the highest in L_1 (0.091 per cent) followed by L_2 (0.084 per cent); and L_3 (0.077 per cent). The three treatments significantly differed from one another. The potassium content of the pseudostem was the highest in L_1 (4.634 per cent). This was followed by L_2 (4.216 per cent) and L_3 (3.862 per cent); the two treatments being statistically on par.

The nitrogen content of the leaves was the highest in L_1 (1.237 per cent) followed by L_2 (1.061 per cent) and L_3 (0.873 per cent). The three treatments differed significantly from one another. The phosphorus content of the leaves was the highest in L_1 (0.181 per cent) followed by L_2 (0.166 per cent) and L_3 (0.158 per cent). The three treatments were significantly different from one another.

The nitrogen content of the leaf sheath was the highest in L_1 (0.876 per cent) followed by L_2 (0.804 per cent); the two treatments being statistically on par. The lowest nitrogen content of leaf sheath was recorded in L_3 (0.696 per cent). L_2 and L_3 were statistically on par. The phosphorus content of the leaf sheath was the highest in L_1 (0.701 per cent) followed by L_2 (0.651 per cent); the two treatments being statistically on par. The lowest phosphorus content of the leaf sheath was recorded in L_3 (0.567 per cent). The potassium content of the leaf sheath

was the highest in L_1 (3.347 per cent) followed by L_2 (2.816 per cent) and L_3 (2.331 per cent). The three treatments were significantly different from one another.

The nitrogen content of the fruits was the highest in L_1 (0.887 per cent). This was followed by L_2 (0.808 per cent) and L_3 (0.761 per cent); the two treatments being statistically on par. The phosphorus content of the fruits was the highest in L_1 (0.155 per cent) followed by L_2 (0.136 per cent); the two treatments being statistically on par. The lowest phosphorus content of fruit was recorded in L_3 (0.098 per cent). The potassium content of the fruits was the highest in L_1 (1.687 per cent) followed by L_2 (1.552 per cent); the two treatments being statistically on par. The lowest potassium content of fruits was recorded in L_3 (1.378 per cent).

The time of leaf pruning significantly influenced the nutrient content of all the plant parts in 'Palayankodan' except the phosphorus content of the corm and leaf sheath. The nitrogen content of the corm was the highest in I_3 (1.051 per cent) followed by I_2 (0.987 per cent); the two treatments being statistically on par. The lowest nitrogen content of corms was recorded in I_1 (0.824 per cent). The potassium content of the corms was the highest in I_3 (4.261 per cent) followed by I_2 (4.067 per cent) and I_1 (3.725 per cent); the former two treatments being statistically on par.

The nitrogen content of the pseudostem was the highest in I_3 (0.695 per cent) followed by I_2 (0.674 per cent); the two treatments being statistically on par. The lowest nitrogen content of pseudostem was recorded in I_1 (0.504 per cent). The phosphorus content of the pseudostem was the highest in I_3 (0.090 per cent) followed by I_2 (0.085 per cent); the two treatments being statistically on par. The lowest phosphorus content of pseudostem was recorded in I_1 (0.078 per cent). The potassium content of the pseudostem was the highest in I_3 (4.543 per cent) followed by I_2 (4.307 per cent); the two treatments being statistically on par. The lowest potassium content of pseudostem was recorded in I_1 (3.861 per cent).

The nitrogen content of the leaf was the highest in I_3 (1.195 per cent) followed by I_2 (1.082 per cent) and I_1 (0.892 per cent). The three treatments were significantly different from one another. The phosphorus content of the leaf was the highest in I_3 (0.177 per cent) followed by I_2 (0.169 per cent) and I_1 (0.159 per cent). The former two treatments were statistically on par. The potassium content of the leaf was the highest in I_3 (2.594 per cent). This was followed by I_2 (2.380 per cent) and I_1 (2.346 per cent); the two treatments being statistically on par.

The nitrogen content of the leaf sheath was the highest in I_3 (0.863 per cent) followed by I_2 (0.817 per cent) and I_1 (0.697 per cent). The former two treatments were statistically on par. The potassium content of the leaf sheath was the highest in I_3 (3.386 per cent) followed by I_2 (2.890 per cent). The lowest value was recorded in I_1 (2.218 per cent). The three treatments significantly differed from one another.

The nitrogen content of the fruit was the highest in I_3 (0.877 per cent) followed by I_2 (0.843 per cent); the two treatments being statistically on par. The lowest value was recorded in I_1 (0.736 per cent). The phosphorus content of the fruits was the highest in I_3 (0.140 per cent) followed by I_2 (0.139 per cent); the two treatments being statistically on par. The lowest value was recorded in I_1 (0.110 per cent). The potassium content of the fruits was the highest in I_3 (1.656 per cent) followed by I_2 (1.603 per cent); the two treatments being statistically on par. The lowest value was recorded in I_1 (1.358 per cent).

The above results indicated that the combined effect of the time of pruning and area of lamina removed had lesser influence on the nutrient status of various plant parts in cv. Palayankodan. The nitrogen content of leaf and potassium content of leaf sheath were significantly lower in the severe pruning

levels and the removal of more than 25 per cent of the leaf area prior to 15 days of unfurling.

The individual effect of the extent of leaf area removed indicated that in general removal of 25 per cent leaf area resulted in a higher NPK status in various plant tissues than that of 50 per cent or 75 per cent.

The time of removal of leaf lamina also had an influence on the tissue levels of major nutrients. Here also, retention of leaves for more number of days resulted in a higher level of nutrients in the plant tissues. Retention of leaves for more than 15 days resulted in a higher nutrient status of the plant parts.

In general, it can be concluded that the combined effect of leaf area removed and the time of pruning did not have a very marked influence on the content of the major nutrients in the plant parts of both 'Njalipoovan' and 'Palayankodan'. However their individual effects were marked. With the increase in the severity of pruning, the content of major nutrients in the plants decreased. It was observed that the removal of more than 25 per cent of the leaf area prior to 15 or 30 days of unfurling resulted in a lower nutrient content of the plant tissues in both the cultivars.

4.5 Effect of leaf pruning on the cost of cultivation, net profit and benefit/cost ratio of banana cvs. Njalipoovan and Palayankodan

The detailed cost of cultivation in Appendix - II and its abstract presented in Table 20 revealed that in 'Njalipoovan', the cost of cultivation was higher in all the treatment plants (Rs. 114958.64 ha^{-1}) compared to the control plants (Rs. 109045.04 ha^{-1}). The total income per hectare was the highest in the control (L_0I_0) plants (Rs. 144480.00 ha^{-1}), followed by L_2I_3 (Rs. 126527.50 ha^{-1}), L_2I_2 (Rs. 119587.30 ha^{-1}), L_1I_3 (Rs. 119583.00 ha^{-1}), L_3I_3 (Rs.119234.70 ha^{-1}), L_2I_1 (115364.70 ha^{-1}), L_1I_2 (Rs. 109091.00 ha^{-1}) and L_3I_2 (Rs.102787.20 ha^{-1}). The lowest total income per hactare was observed in L_3I_1 (Rs.89947.40 ha^{-1}) followed by L_1I_1 (Rs.95030.00 ha^{-1}).

The income from fruits was the highest in the control plants (Rs. 111198 ha^{-1}) followed by L_1I_3 (Rs.86301 ha^{-1}), L_1I_2 (Rs. 79593 ha^{-1}), L_2I_3 (Rs.68241 ha^{-1}), L_1I_1 (Rs. 66564 ha^{-1}), L_3I_3 (Rs.65532 ha^{-1}), L_2I_2 (Rs. 62307 ha^{-1}) and L_2I_1 (Rs. 60372 ha^{-1}). The lowest income from fruits was recorded in L_3I_1 (Rs.41151 ha^{-1}) followed by L_3I_2 (Rs.50439 ha^{-1}). The income from leaves was the highest in L_2I_1 (Rs.28160.70 ha^{-1}) followed

Table 20 Effect of leaf pruning on the cost of cultivation, net profit and benefit/cost ratio of banana cvs. Njalipoovan and Palayankodan (Abstract)

Treatment	Cost of cultivation (Rs. ha^{-1})	Income (Rs. ha^{-1})				Profit (Rs.ha^{-1})	Loss (Rs.ha^{-1})	Benefit/cost ratio
		Fruits	Suckers	Leaves	Total			
NJALIPOOVAN								
L_0I_0	109045.04	111198.00	33282.00	-	144480.00	35434.96	-	1.32
L_1I_1	114958.64	66564.00	28466.00	-	95030.00	-	19928.64	0.83
L_1I_2	114958.64	79593.00	29498.00	-	109091.00	-	5867.64	0.95
L_1I_3	114958.64	86301.00	33282.00	-	119583.00	4624.36	-	1.04
L_2I_1	114958.64	60372.00	26832.00	28160.70	115364.70	406.06	-	1.00
L_2I_2	114958.64	62307.00	30616.00	26664.30	119587.30	4628.66	-	1.04
L_2I_3	114958.64	68241.00	31648.00	26638.50	126527.50	11568.86	-	1.10
L_3I_1	114958.64	41151.00	21500.00	27296.40	89947.40	-	25011.24	0.78
L_3I_2	114958.64	50439.00	25800.00	26548.20	102787.20	-	12171.44	0.89
L_3I_3	114958.64	65532.00	26832.00	26870.70	119234.70	4276.06	-	1.04
PALAYANKODAN								
L_0I_0	109130.18	101372.50	23800.50	-	125173.00	16042.82	-	1.15
L_1I_1	115043.78	79657.50	19737.00	-	99394.50	-	9070.28	0.86
L_1I_2	115043.78	91482.50	21768.75	-	113251.25	-	1792.53	0.98
L_1I_3	115043.78	92127.50	23365.00	-	115492.50	448.72	-	1.01
L_2I_1	115043.78	68907.50	18479.25	22385.70	109772.45	-	5271.33	0.95
L_2I_2	115043.78	76325.00	20559.50	23865.00	120749.50	5705.72	-	1.05
L_2I_3	115043.78	76432.50	20946.50	23439.30	120818.30	5774.52	-	1.05
L_3I_1	115043.78	45365.00	12094.00	24510.00	81969.00	-	33074.78	0.71
L_3I_2	115043.78	47085.00	15738.00	22575.00	85398.00	-	29645.78	0.74
L_3I_3	115043.78	63425.00	16931.25	22252.50	102608.75	-	12435.03	0.89

by L_3I_1 (Rs.27296.40 ha^{-1}). This was followed by L_3I_3 (Rs.26870.70 ha^{-1}), L_2I_2 (Rs.26664.30 ha^{-1}) and L_2I_3 (Rs.26638.50 ha^{-1}). The lowest income from leaves was recorded in L_3I_2 (Rs. 26548.20 ha^{-1}).

The net profit per hectare was the highest in the control plants (Rs.35434.96 ha^{-1}). This was followed by L_2I_3 (Rs.11568.86 ha^{-1}), L_2I_2 (Rs.4628.66 ha^{-1}) and L_1I_3 (Rs.4624.36 ha^{-1}). The lowest net profit per hectare was recorded in L_2I_1 (Rs.406.06 ha^{-1}) followed by L_3I_3 (Rs.4276.06 ha^{-1}). The treatments L_1I_1, L_1I_2, L_3I_1 and L_3I_2, showed loss of income. The net loss per hectare was the highest in L_3I_1 (Rs.25011.24 ha^{-1}), followed by L_1I_1 (Rs.19928.64 ha^{-1}) L_3I_2 (Rs.12171.44 ha^{-1}) and L_1I_2 (Rs. 5867.64 ha^{-1}).

The highest benefit/cost ratio was recorded in the control plants (1.32) followed by L_2I_3 (1.10), L_1I_3 (1.04), L_2I_2 (1.04) and L_3I_3 (1.04). This was followed by L_2I_1 (1.00). The lowest benefit/cost ratio was recorded in L_3I_1 (0.78) followed by L_1I_1 (0.83), L_3I_2 (0.89) and L_1I_2 (0.95).

In the treatments L_1I_1, L_1I_2 and L_1I_3, the cost of leaf was not included in the profit since the leaf obtained from pruning was not of marketable size.

Considering the total income and net returns, the control plants gave the maximum returns from fruits and the highest total income per hectare. This was followed by L_2I_3, L_1I_3, L_2I_2, L_3I_3, L_2I_1, L_1I_2, L_3I_2, L_1I_1 and L_3I_1. The above results indicated that pruning of leaves resulted in lower total income and net profit. If at all leaf pruning is to be undertaken, it is desirable to prune only upto 50 per cent of the lamina after 30 days of unfurling.

In 'Palayankodan' also, the cost of cultivation was higher in all the treatment plants (Rs.115043.78 ha^{-1}) compared to the control plants (Rs. 109130.18 ha^{-1}). The total income per hectare was the highest in the control plants (Rs.125173.00 ha^{-1}) followed by L_2I_3 (Rs.120818.30 ha^{-1}), L_2I_2 (Rs.120749.50 ha^{-1}), L_1I_3 (Rs.115492.50 ha^{-1}), L_1I_2 (Rs.113251.25 ha^{-1}), L_2I_1 (Rs.109772.45 ha^{-1}) and L_3I_3 (Rs.102608.75 ha^{-1}). The lowest total income per hectare was recorded in L_3I_1 (Rs.81969.00 ha^{-1}), L_3I_2 (Rs.85398.00 ha^{-1}) and L_1I_1 (Rs.99394.50 ha^{-1}).

The income from fruits was the highest in the control plants (Rs.101372.50 ha^{-1}) followed by L_1I_3 (Rs.92127.50 ha^{-1}), L_1I_2 (Rs.91482.50 ha^{-1}), L_1I_1 (Rs. 79657.50 ha^{-1}), L_2I_3 (Rs.76432.50 ha^{-1}) and L_2I_2 (Rs.76325.00 ha^{-1}). This was followed by L_2I_1 (Rs.68907.50 ha^{-1}), L_3I_3 (Rs.63425.00 ha^{-1}) and L_3I_2 (Rs.47085.00 ha^{-1}). The lowest income from fruits was recorded in L_3I_1 (Rs.45365.00 ha^{-1}).

The income from leaves was the highest in L_3I_1 (Rs.24510.00 ha^{-1}), followed by L_2I_2 (Rs.23865.00 ha^{-1}), L_2I_3 (Rs.23439.30 ha^{-1}) and L_3I_2 (Rs.22575.00 ha^{-1}). The lowest income from leaves was recorded in L_3I_3 (Rs.22252.50 ha^{-1}).

The net profit per hectare was the highest in the control plants (Rs.16042.82 ha^{-1}) followed by L_2I_3 (Rs.5774.52 ha^{-1}) and L_2I_2 (Rs.5705.72 ha^{-1}). The lowest net profit per hectare was recorded in L_1I_3 (Rs.448.72 ha^{-1}). The treatments L_1I_1, L_1I_2, L_2I_1, L_3I_1, L_3I_2 and L_3I_3 showed loss of income. The net loss per hectare was the highest in L_3I_1 (Rs.33074.78 ha^{-1}) followed by L_3I_2 (Rs.29645.78 ha^{-1}), L_3I_3 (Rs.12435.03 ha^{-1}) and L_1I_1 (Rs.9070.28 ha^{-1}). The lowest net loss per hectare was recorded in L_1I_2 (Rs.1792.53 ha^{-1}) followed by L_2I_1 (Rs.5271.33 ha^{-1}).

The benefit/cost ratio was the highest in the control plants (1.15) followed by L_2I_2 (1.05), L_2I_3 (1.05) and L_1I_3 (1.00). The lowest benefit/cost ratio was recorded in L_3I_1 (0.71) followed by L_3I_2 (0.74), L_1I_1 (0.86), L_3I_3 (0.89), L_2I_1 (0.95) and L_1I_2 (0.98).

In the treatments L_1I_1, L_1I_2 and L_1I_3, the cost of leaf was not included in the profit since the leaf obtained from pruning was not of marketable size.

Considering the total income and net returns, the control plant in which no leaves were pruned, gave the maximum returns from fruits and the highest total returns per hectare. This was followed by L_2I_2, L_2I_3, L_1I_3, L_1I_2, L_2I_1, L_3I_3, L_1I_1, L_3I_2 and L_3I_1. The above results indicated that it is desirable to prune only upto 50 per cent of the leaf area after 30 days of unfurling if at all leaf pruning is to be taken up.

It was also observed that net returns was higher in 'Njalipoovan' compared to 'Palayankodan'. Therefore it is assumed that 'Njalipoovan' is more suitable for leaf pruning than Palayankodan from the economic point of view.

DISCUSSION

DISCUSSION

Banana is one of the important tropical fruit crops of the world. It is commercially grown from the equator to a latitude of 30° or more. Yield in a banana plantation is a function of bunch mass, bunch number per hectare and crop cycle time. It is thought that a banana plant produces more leaves than required for normal development. Excess leaf area and a thick pseudostem could explain why the harvest index in banana is much lower than most other fruit crops.

Experimental leaf pruning in banana has mostly been applied before flowering either to simulate leaf loss due to insect or disease damage (Ostmark, 1974) or to extend the cycle time for crop timing purposes (Turner and Hunt, 1987). Banana plants were selectively pruned by Pillai and Shanmugavelu (1977) and by Satyanarayana (1985). They found a delay in flowering time and reduction of bunch mass when leaf number was continually maintained at six compared with eighteen. However experiments in Honduras (Stover and Simmonds, 1987) indicated that when defoliation in the mother plant left as few as seven leaves at flowering, ratoon sucker growth was accelerated. This suggests that increased light penetration may be involved. There are pronounced differences in the photosynthetic efficiency of banana leaves due to leaf age, leaf water potential, cultivar and light

intensity. The possibility exists therefore that some compensatory photosynthetic boost may occur in the remaining leaves on pruned plants.

The present investigations were designed to find out the extent of leaf area that can be sacrificed without affecting yield by way of removal or disease incidence. During the course of the experiment, plant growth, yield and quality of the produce under different levels and intervals of leaf pruning were critically observed and the results obtained are discussed below.

5.1 Effect of leaf pruning on the vegetative characters of banana cvs. Njalipoovan and Palayankodan

5.1.1 Effect of leaf pruning on plant height and girth of banana cvs. Njalipoovan and Palayankodan

The results of the study indicated that the combined effect of leaf area removed and the time of pruning did not significantly influence the plant height in both 'Njalipoovan' and 'Palayankodan'. However the effect of leaf area removed or the time of pruning when considered individually, exerted a depressing effect on the height of 'Palayankodan' plants indicating that this cultivar is more prone to the deleterious effects of leaf pruning compared to 'Njalipoovan'.

The girth of plants in both the cultivars was not significantly influenced by the combined effect of leaf area removed and the time of pruning or their individual effects.

The studies on the growth characters of different banana varieties had led to the general impression that the banana plant produced more leaves than that is required for normal fruit development (Stover and Simmonds, 1987). Partial defoliation studies in banana were conducted by several research workers. Martinez (1984) reported no effect of defoliation on either plant height or girth of banana var. Dominica Harton. The above reports are in agreement with the general conclusions made from the present investigation on plant height and girth. However Basu (1901) in Athia variety of banana, Pillai (1975) in 'Poovan' banana, Kothawavade et al. (1985) and Satyanarayana (1985) in 'Basrai' banana have observed that partial defoliation resulted in decreased growth in terms of height, girth etc. This controversial situation may be due to the differences in the varietal response to leaf pruning in banana as observed in the present studies, wherein 'Njalipoovan' was found to be comparatively less affected by the pruning intensities imposed.

5.1.2 Effect of leaf pruning on leaf characters of banana cvs. Njalipoovan and Palayankodan

The present investigation on the effect of leaf pruning on the leaf characters indicated that either the combined effect of the extent of leaf area removed and the time of pruning or

their individual effects did not significantly influence the total number of leaves produced in both 'Njalipoovan' and 'Palayankodan'.

The combined effect of the extent of leaf area removed and the time of pruning or their individual effects did not significantly influence the phylachron in both the varieties.

Leaf longevity, in general, increased with the severity of pruning. The extent of lamina removed had more pronounced effect than the time of pruning. The response of the two varieties differed with respect to leaf longevity. 'Njalipoovan' responded more to leaf pruning than 'Palayankodan'.

The functional leaf area decreased with the severity of pruning in both the cultivars. Both the leaf area removed and the time of pruning affected the functional leaf area. In general, removal of more than 50 per cent leaf area before 15 days of unfurling had more deleterious effect.

The extent of leaf area removed and the time of pruning influenced the leaf area index and leaf area duration in both 'Njalipoovan' and 'Palayankodan'. The removal of more than 50 per cent leaf area prior to 30 days after unfurling had the most deleterious effect.

According to Simmonds (1966), in banana, growth is a function of the number of leaves produced. A fixed number of

leaves emerge prior to flowering (Summerville, 1944; Champion, 1963 and Wardlaw, 1972). The reports by Turner (1970b) and Nambisan and Rao (1980) indicated that leaf production, phylachron, leaf area and leaf area duration are distinct for each group of clones.

The present studies on the effect of leaf pruning on the total number of leaves produced indicated that the pruning treatments imposed did not significantly influence the total number of leaves produced either in 'Njalipoovan' or 'Palayankodan'. This result is in conformity with the above reports which indicated that the number of leaves produced being more dependent on the varietal characteristics, may be influenced to a lesser extent by other factors. From the studies in similar lines, Pillai and Shanmugavelu (1976) also observed that the total number of leaves produced was not influenced by leaf pruning in 'Poovan'. Findings of Turner and Hunt (1987) suggested the existence of an internal mechanism to compensate the depletion of lamina through the production of a few extra leaves. In the present studies, production of a notable number of extra leaves was not observed but an extra three leaves were produced in the most severe form of pruning in 'Palayankodan'. Thus it seems that the varietal characteristics had influenced the production of leaves rather than the pruning strategies adopted.

The present studies also indicated that the phylachron, that is, the interval of emergence of successive leaves was also not significantly influenced by the leaf pruning strategies adopted in 'Njalipoovan' and 'Palayankodan'. According to Anslow (1966), the phylachron depends upon temperature and the assimilation of expanded leaves. According to Pillai and Shanmugavelu (1976), under leaf pruning treatments, phylachron decreased with increase in the number of functional leaves and the level of functional leaves remained had probably a control over phylachron. Kelley (1932), Kramer (1969) and Devlin (1973) have suggested that removal of some leaves may result in water loss and loss of turgidity in the remaining leaves due to exposure to solar radiation and this may result in delay in unfolding of leaves. Based on the above findings, it is possible to assume that the more or less constant rate of leaf emergence is due to the constant level of total number of leaves present. Since the present studies were done by partial removal of the lamina, the exposure to solar radiation of the remaining portion of the lamina might not have become a limiting factor leading to loss of turgidity.

Eventhough the longevity of the remaining intact portion of the leaves was not very notably affected by the leaf pruning strategies adopted, in general it was observed that, with

the severity of pruning, the longevity of the intact portion increased slightly.

Turner and Hunt (1987) as well as Robinson *et al.* (1992) have suggested the existence of some internal mechanism to compensate the depletion of lamina in banana plants. The former group also observed that defoliation at certain stages of growth affected the leaf longevity in the post floral phases. Earlier reports of Pillai and Shanmugavelu (1976) in 'Poovan' also indicated that the number of leaves emerged outside the pseudostem varied with the leaf pruning levels. Retention of all the leaves resulted in comparatively lower number of leaves on the pseudostem. The above reports are in conformity with the present findings in that the levels of leaf pruning affect the longevity of the existing leaves and this may be one of the adaptations to compensate for the loss of lamina.

The present studies indicated that the functional leaf area decreased with the severity of pruning both in 'Njalipoovan' and 'Palayankodan' under the influence of the extent of lamina removed as well as the time of pruning. The treatments influenced the leaf area index and leaf area duration also. In general, removal of more than 50 per cent leaf area prior to 30 days after unfurling had more deleterious effect. From studies

on similar lines, Pillai and Shanmugavelu (1976) observed that in 'Poovan' the highest leaf area was recorded from the plants which retained all the leaves. This is in agreement with the result of the present studies. The number of leaves produced or the phylachron was not significantly influenced by the treatments in the present studies and hence with the severity of pruning, there was a reduction in the functional leaf area and leaf area index. The land area occupied by the plants in the different treatments being the same, the leaf area index might have been more dependent on the leaf area. Similarly, leaf area duration being a function of the leaf area and longevity might have behaved in harmony with the trend of longevity and leaf area under the influence of different treatments. The differences in the longevity of intact portion of leaves in different treatments being only slight, the influence of leaf area might have become more pronounced bringing in the differences in leaf area duration under the influence of the treatments. Hartman and Bailey (1929) have reported complete recovery of the leaf surface after defoliation in some instances in banana. This might have been the result of change in phylachron and the total number of leaves produced. In the present studies however, these two factors were not significantly influenced by the treatments and hence the changes in functional leaf area, leaf area index and leaf area duration were observed under the influence of the pruning

treatments imposed through the differences in the leaf area remained after pruning.

5.1.3 Effect of leaf pruning on the relative growth rate of banana cvs. Njalipoovan and Palayankodan

The studies indicated that the combined effect of time of pruning and the extent of leaf area removed did not significantly influence the relative growth rate in terms of plant height in both 'Njalipoovan' and 'Palayankodan'. However the individual effect of the time of pruning was more pronounced than the extent of leaf area removed. In general, pruning of leaves prior to 15 days of unfurling had more deleterious effect on the relative growth rate.

Basu (1901) had reported that too much leaf cutting reduces the growth of even hardy banana varieties like 'Athia'. According to Kothavade et al. (1985), the increase in the number of functional leaves had promoting effect on plant height. Satyanarayana (1985) reported that in 'Basrai' banana, number of functional leaves did not influence plant height. Thus, from the above reports, it becomes evident that the response to leaf pruning treatments in relation to plant height is more or less dependent on the varietal characteristics and the severity of pruning. In the present studies, it was observed that the plant

height was not significantly influenced by the combined effect of the extent leaf area removed and the time of pruning. However the time of pruning influenced the height in 'Palayankodan' to some extent but not in 'Njalipoovan'. Since the relative growth rate in the present investigation was expressed in terms of plant height at different time intervals, the relative growth rate might have been influenced by the trend observed in the changes in plant height. Thus based on the present findings and related works on similar lines, it can be assumed that the relative growth rate was little affected under moderate leaf pruning. It is also assumed that the response to pruning may be to some extent due to varietal characteristics.

5.1.4 Effect of pruning on the time taken for bunch emergence, bunch maturity and crop duration in banana cvs. Njalipoovan and Palayankodan .

The studies indicated that the time taken for bunch emergence and bunch maturity were influenced by the pruning treatments. However the crop duration was not affected significantly. The individual effects of extent of lamina removed and the time of pruning showed that when the extent of lamina removed was lesser or the period of retention was longer, the time taken for bunch emergence decreased upto a level of

pruning intensity. The time taken for bunch emergence in both the cultivars was shorter when only 25 to 50 per cent of the lamina was removed 30 days after unfurling.

Leaf production in banana is related to flower induction. The number of leaves that emerge and the number of leaves inside the pseudostem have been related with floral initiation based on the production of a fixed number of leaves in total (Ticho, 1960; Champion, 1961; Turner, 1970b and Wardlaw 1972). In the present studies also, the response on bunch emergence was found to exist upto a level of pruning. This view is supported by the observation in 'Basrai' by Kothavade et al. (1985). The combined effect of the treatments on bunch emergence in 'Palayankodan' showed significant difference between the treatments but there was the production of a few extra leaves in more severe pruning treatments though the difference was not significant. This might have resulted in a change in the Ts values and might have resulted in the changes in the time of flowering due to pruning in the two varieties. According to Naik (1963) and Turner (1970b), the number of leaves produced before flowering vary with cultivars. The number of leaves produced by the treatment plants in the present studies is in agreement with the values recorded by Nambisan (1972). Thus based on the present studies and earlier reports in similar lines, it becomes evident that leaf pruning influence the time of flowering in banana. It was also

noted that with the increase in the intensity of leaf pruning, the time taken for flowering increased.

The present studies on the effect of leaf pruning on time taken for bunch maturity showed that removal of more than 50 per cent of the lamina prior to 30 days of unfurling resulted in shorter bunch maturity period compared to less severe form of pruning treatments imposed. This indicates that bunch maturity in the cultivars studied was influenced by the level of pruning. This is in agreement with the results of the studies conducted by Hartman and Bailey (1929). Wardlaw (1972) and Pillai (1975) also observed that decrease in the number of functional leaves is liable to cause such effects on bunch formation and its maturity. According to Stover (1974), Ramsey et al. (1990) and Robinson et al. (1992) a certain number of leaves are required for flowering and proper maturity of bunches in banana. These reports are indicative of the requirement of a balanced level of leaf area for proper bunch maturity which is observed from the current studies also.

In general, with respect to crop duration, there was no significant difference between the leaf pruning treatments imposed. However, the individual effect of the time of pruning had an impact on the crop duration in 'Njalipoovan'. It was observed that pruning of leaves prior to 15 days of unfurling resulted in a decrease in crop duration in this cultivar.

Earlier reports in these lines agree with the current findings. Ticho (1960) has suggested defoliation as a measure to regulate crop duration in banana. According to Turner (1970a), the number of leaves prior to flowering influences the maturation and harvest in banana. Delay in harvest time due to supra optimum levels of leaf area was reported by Kothvade et al. (1985) in 'Basrai' and Turner and Hunt (1987) in 'Williams' also. In a similar study, Pillai (1975) also observed that the number of leaves remaining on the psuedostem influences crop duration. Lesser number of leaves resulted in the extension of crop duration as observed in 'Njalipoovan' in the present studies under the influence of time of pruning.

5.1.5 Effect of leaf pruning on the number of suckers produced in banana cvs. Njalipoovan and Palayankodan.

The results of the studies indicated that the combined effect of extent of leaf area pruned and the time of pruning did not significantly affect the sucker production in 'Palayankodan' or 'Njalipoovan'. However considering the individual effects of the treatments, it appears that the removal of 25 to 50 per cent of the leaf lamina 15 to 30 days after unfurling resulted in more number of suckers per plant. Studies on similar lines by Turner (1970 b) also revealed that the plant water relations and the sucker growth were influenced by the level of defoliation in

'Williams' banana. The later reports of Turner (1976) and Stover and Simmonds (1987) also gives an indication of a threshold level of leaf area which influences sucker production in banana in relation to light penetration. These reports are in agreement with the present studies. However there are reports indicating the genomic constitution of the cultivar in relation to sucker production also. (Nambisan, 1972; Shanmugavelu and Balakrishnan, 1980 and Stover and Simmonds, 1987). Thus it appears that basically sucker production is dependent on genetic constitution, but it can be slightly altered by defoliation, water relations and light penetration as evidenced from the present results as well as earlier works on similar lines.

5.1.6 Effect of leaf pruning on dry matter production of banana cvs. Njalipoovan and Palayankodan

The studies indicated that in both 'Njalipoovan' and 'Palayankodan', there was no significant reduction in dry matter production in the vegetative parts due to the combined effect of extent of leaf area removed and the time of pruning. However the individual effect of extent of leaf area removed was more pronounced bringing in changes in dry matter production. It was also observed that in 'Njalipoovan', the dry matter production in bunch as well as the total dry weight were significantly affected. In general, removal of more than 50 per cent leaf area

prior to 15 days after unfurling affected the dry matter production more adversely. Thus the results indicated that the intensity of leaf pruning had some bearing on the dry matter production.

The present studies on the effect of leaf pruning on vegetative characters revealed that the plant height, girth and number of leaves produced did not vary significantly under the combined effect of extent of leaf area removed and the time of pruning in both the cultivars. This may be the reason for the less pronounced effect of dry matter production on the vegetative parts. In 'Njalipoovan', the dry weight of the bunches was found to be affected by the treatments. The longevity of leaves, the leaf area index and the functional leaf area in 'Njalipoovan'at harvest stage was found to be significantly affected by the leaf pruning treatments but these kind of differences were not observed in 'Palayankodan'. This may be the reason for the differences in the dry matter production in the bunches in 'Njalipoovan'. The larger leaf area and the longer life of leaves might have helped 'Palayankodan' to compensate the lamina loss by way of pruning at least to some extent and the disadvantages in this respect to 'Njalipoovan' might have resulted in deleterious effects. Thus the differences in the bunch dry matter production might have reflected in decreased total dry matter production in 'Njalipoovan'. Such differences

significantly affected the bunch weight, number of hands, number of fingers or the yield per hectare in 'Njalipoovan' while there was significant difference in these characters except the number of hands in 'Palayankodan'. However when the individual effect of the leaf area removed or the time of pruning was considered, both the cultivars showed decrease in yield and yield attributes with increase in the severity of pruning. In general, removal of more than 25 per cent of leaf area prior to 30 days of unfurling had more deleterious effect on yield compared to other intensities of leaf pruning. The results also showed that in terms of yield, 'Palayankodan' was more prone to the ill-effects of leaf pruning compared to 'Njalipoovan'.

Yield in banana is positively correlated with the number of hands, number of fingers, number of functional leaves per plant, girth of stem and duration of crop. Path co-efficient analysis showed that the number of fingers had high positive direct effect on yield in 'Nendran' banana (Kurian et al., 1985). Simmonds (1966) and Turner (1980) had found that leaf area and leaf area duration are correlated with plant height, girth, number of hands and number of fingers in the plant crop.

In the present study, it was observed that the functional leaf area did not vary significantly an 'Njalipoovan' under the combined effect of leaf area removed and the time of

pruning except at the harvest stage. However, the individual effects of the treatments had some bearing on the functional leaf area. It appears that this cultivar is comparatively hardy and hence is able to maintain the required leaf area to support the bunches in spite of the differences in the number of functional leaves and leaf area duration due to the treatment effects. This sort of pruning responses depending on the level of pruning was reported by Turner (1970a), Krishnan and Shanmugavelu (1983), Martinez (1984) and Turner and Hunt (1987) in different banana cultivars. However, in 'Palayankodan', this sort of compensation mechanism may be weaker and hence the variety was more prone to reduction in bunch weight and total yield. Moreover, the number of fingers per bunch was altered significantly in 'Palayankodan' but not in 'Njalipoovan'. Such relations in different banana varieties were observed by Simmonds (1966), Turner (1980) and Kurian et al. (1985).

Eventhough the combined effect was not pronounced in relation to plant height, 'Palayankodan' responded to the individual effect of extent of leaf area removed and the time of pruning in the different pruning treatments. But such variations in plant height was very less pronounced in 'Njalipoovan'. Simmonds (1966) has correlated the plant height with the variation in yield in 'Valery' banana which is in agreement with the present results.

In general, the reduction in bunch weight, total yield, and the number of hands and fingers in response to the individual effects of the severity of pruning were observed in both the varieties. This is supported by the results obtained by Pillai and Shanmugavelu (1978), Chakrabarthy and Rao (1980), Turner (1980), Krishnan and Shanmugavelu (1983), Martninez (1984), Kothavade et al (1985) and Turner and Hunt (1987).

5.2.2 Effect of leaf pruning on the fruit characters of banana cvs. Njalipoovan and Palayankodan

The present studies indicated that the combined effect of leaf area removed and the time of pruning had less marked effect on the fruit characters such as girth, fruit weight and pulp weight in 'Palayankodan'. However in 'Njalipoovan', the fruit weight and pulp weight differed significantly. The individual effect of the pruning strategies had a more pronounced effect on the length of fruit, girth of fruit, weight of fruit and pulp weight of fruit. Removal of upto 50 per cent of leaf area 15 days after unfurling had lesser deleterious effect on the above fruit characters.

Reduction in fruit size in terms of length, girth and weight as observed in the present studies are reported from studies on similar lines. Pillai and Shanmugavelu (1978) have

observed reduction in fruit weight, volume, length, peel weight and pulp weight in relation to the intensity of pruning in 'Poovan' banana. They have also reported changes in pulp/peel ratio under different leaf pruning intensities which is in agreement with the present findings. Decrease in fruit size in 'Basrai' banana with higher intensities of leaf pruning reported by Satyanarayana (1985), decrease in finger weight in 'Williams' banana observed by Turner and Hunt (1987) and reduction of finger length in 'Williams' banana due to different levels of pruning reported by Robinson et al. (1992) are also in agreement with the results obtained in the present studies.

5.3 Effect of leaf pruning on fruit quality of banana cvs. Njalipoovan and Palayankodan

The results indicated that the combined effect of extent of lamina removed and the time of pruning affected the quality of fruits of 'Palayankodan' to a greater extent compared to 'Njalipoovan' especially the TSS and the sugar content. The individual effect also had influenced the sugar content and the carbohydrate content. The green life of fruits was not significantly affected by the different pruning levels. Comparing the responses of the cultivars, it was observed that in 'Palayankodan', there was more deterioration in fruit quality than in 'Njalipoovan'. Severe pruning levels had more

deleterious effect on fruit quality in general. Studies on similar lines by Pillai and Shanmugavelu (1978) also have shown that the fruit quality in 'Poovan' in terms of TSS, sugars and sugar/acid ratio was related with functional leaf area. However Kothavade et al. (1985) has reported the difference that fruit quality reduction takes place only when the leaf pruning exceeds a threshold level. This may be the reason for the difference in the response to leaf pruning between the cultivars under study. As discussed under the yield characters, it appears that 'Njalipoovan' somehow is able to compensate the loss of lamina through some appropriate mechanism. Thus the above reports are in agreement with the present results. Similar reports of reduction in quality in response to defoliation is reported by Kliewer and Weaver (1971), Reddy et al. (1978) and Anonymous (1985) in grapes. In the present study the green life of the fruits remained more or less unaffected by the pruning treatments imposed eventhough the extent of removal of leaf area had influence on the green life. This is in agreement with the report of Robinson et al. (1992) who observed that retention of a very small number of five leaves per plant only at flowering resulted in changes in green life of ripe banana fruits.

5.4 Effect of leaf pruning on the nutrient uptake of banana cvs. Njalipoovan and Palayankodan

From the present investigations, it became evident that the combined effects of leaf area removed and the time of pruning

did not have a very pronounced effect on the content of major nutrients in the plant parts of 'Njalipoovan' and 'Palayankodan'. However their individual effects were more marked. With the increase in the severity of pruning, the content of nitrogen, phosphorus and potassium content in the plant parts decreased. It was observed that the removal of more than 25 per cent of leaf area prior to 15 to 30 days of unfurling resulted in a lower nutrient status in both the cultivars.

The studies on similar lines by Pillai (1975) also indicated that in banana cv. Poovan, uptake of nitrogen, phosphorus and potassium was comparatively higher in plants with more number functional leaves, supporting the results of the present studies. Decrease in the major nutrient content under defoliated conditions was reported in plum by Castagnolis *et al.* (1989) and in rubber by Senechal and Gohet (1988) also.

5.5 Effect of leaf pruning on the benefit/cost ratio of banana cvs. Njalipoovan and Palayankodan

The studies indicated that from the economic point of view, leaf pruning is not beneficial in both 'Njalipoovan' and 'Palayankodan' under Kerala conditions. It was observed that the yield and returns were higher in control plants where no leaf pruning was practised. A comparative study showed that the net

returns were higher in 'Njalipoovan' than 'Palayankodan'. If at all leaf pruning is to be done, the intensity of pruning should be removal of only upto 50 per cent of the lamina after 30 days of unfurling.

Leaf pruning is definitely not recommended as a common practice due to bunch mass reduction, green life reduction, possible deterioration of fruit quality and the labour cost of pruning. For improved bunch mass and yield, management of the plantation should be good enough to ensure maximum number of functional leaves on the plant at flowering stage (Anon, 1988). This finding is in agreement with the result obtained from the present studies. Robinson et al. (1992) also observed that no yield benefit was achieved by leaf pruning in 'Williams' banana. Severe loss of lamina result in more economic loss compared to moderate loss of lamina. Similar reduction in yield and gross returns due to decrease in leaf area was reported in other crops like coriander (Bhati, 1988) and coconut (Sudhakara et al., 1989).

The results obtained from the current studies thus indicated that pruning of leaves had adverse effects on the yield and quality of fruits in 'Njalipoovan' and 'Palayankodan'. In general, growth characters like plant height, girth, phylachron, number of leaves produced, relative growth rate and crop duration

were not significantly affected by the pruning treatments imposed. However, functional leaf area, leaf area index and leaf area duration decreased with the intensity of pruning but longevity of the intact portion of the lamina increased. Eventhough leaf pruning induced delay in bunch emergence, bunch maturity period decreased and hence total crop duration remained more or less unaffected. Sucker production did not differ significantly between the treatments. Dry matter production in the vegetative parts was not significantly influenced by leaf pruning in the cultivars under study, but in 'Njalipoovan' the bunch dry matter production decreased with the severity of pruning.

Leaf pruning had a depressing effect on the bunch characters such as the number of hands, number of fingers and bunch weight and the effect was more pronounced in 'Palayankodan'. The size of fruits was also affected by the severity of leaf pruning and the effect was more pronounced in 'Palayankodan' compared to 'Njalipoovan'. The fruit quality, especially TSS, sugar and carbohydrate contents were adversely affected by leaf pruning. The decrease in quality was more pronounced in 'Palayankodan' than 'Njalipoovan'.

The income and net returns were the highest in the plants which maintained all leaves in both the varieties. Severe

leaf pruning decreased the total income and net returns. Returns per unit area was more in 'Njalipoovan' than 'Palayankodan'.

Considering the above facts, it appears that leaf pruning is not an economically viable proposition in 'Njalipoovan' or 'Palayankodan' under the present management and marketing situations in Kerala. Among the leaf pruning treatments tried, removal of lamina upto 50 per cent ~~of the lamina~~ after 30 days of unfurling appears to exert comparatively less adverse effects than more severe form of pruning. Among the two cultivars. 'Njalipoovan' appears to show more ability to withstand this pruning strategy than 'Palayankodan'.

SUMMARY

SUMMARY

The present investigation on 'Regulation of leaf pruning to optimise leaf and bunch harvest in Musa (AB group) Njalipoovan and (AAB group) Palayankodan' was conducted at the Department of Horticulture, College of Agriculture, Vellayani, Thiruvananthapuram during 1993-94 to optimise the vegetative growth of the banana plants in order to create a balance between the growth of vegetative and economic parts so that more energy can be diverted towards the latter. During the course of the experiment, plant growth, yield and quality of the produce under different levels and intervals of pruning were critically observed. The important findings are summarised below.

The plant height was not significantly affected by the combined effect of extent of leaf area removed and the time of pruning. The individual effects of these treatments had a more pronounced influence on the plant height of both 'Njalipoovan' and 'Palayankodan'. Removal of 25 to 50 per cent of leaf area after 15 to 30 days of unfurling had less deleterious effect on vegetative growth. The variety 'Njalipoovan' was comparatively less affected by this leaf pruning strategy compared to 'Palayankodan'.

The girth of the plants of both the varieties was not significantly affected by the leaf pruning treatments imposed.

The treatments also did not have any significant influence on the total number of leaves produced or the phylachron.

The leaf pruning, in general slightly increased the longevity of the intact portion of leaf on the plant. The severest pruning treatment resulted in the longest life and vice versa. The extent of lamina removed had a more pronounced effect on the longevity of leaf than the time of pruning in 'Palayankodan'. Removal of more than 50 per cent of lamina increased the leaf longevity in 'Njalipoovan' as well as in 'Palayankodan'. 'Njalipoovan' responded more to leaf pruning than 'Palayankodan' in relation to extension of leaf life.

The functional leaf area decreased significantly with the severity of leaf pruning in both the cultivars. Both the leaf area removed by way of pruning and time of pruning had effect on the functional leaf area. The removal of more than 50 per cent of the lamina prior to 15 days after unfurling had deleterious effect on the functional leaf area. But removal of 25 to 50 per cent of the leaf lamina after 15 to 30 days of unfurling had less deleterious effect on the functional leaf area of both 'Njalipoovan' and 'Palayankodan'.

The leaf area index and leaf area duration in both 'Njalipoovan' and 'Palayankodan' were significantly influenced by

the extent of lamina removed as well as the time of removal. In general, the removal of leaf area upto 50 per cent ~~of leaf area~~ after 30 days of unfurling was less harmful with respect to leaf area index.

The relative growth rates of 'Njalipoovan' and 'Palayankodan' were less markedly affected by the combined effect of the time of pruning and the extent of leaf area removed. The individual effect of the time of pruning was more pronounced than the extent of leaf area removed. Leaf pruning after 15 days of unfurling had less deleterious effect on the relative growth rate of both the cultivars.

The time taken for bunch emergence and bunch maturity were more significantly affected by the combined effect of the time of pruning and the extent of leaf area removed than the crop duration. When the extent of lamina removed increased or the period of retention was shorter, the time taken for bunch emergence increased but the time taken for bunch maturity decreased. The individual effects of these treatments were more pronounced. The time taken for bunch emergence in both the cultivars was shorter when only 25 to 50 per cent of the lamina was removed. But the bunch maturity period was longer in these levels of pruning. When the time of retention was 30 days after unfurling in both varieties, the duration for bunch emergence was

shorter. In 'Njalipoovan', the crop duration decreased when the leaves were retained for 15 to 30 days after unfurling.

The sucker production in both cultivars was not markedly influenced by the combined effect of the treatments. However, when the individual effects were considered, removal of 25 to 50 per cent leaf area 15 to 30 days after unfurling resulted in more number of suckers per plant.

The dry matter production in both the varieties was adversely affected by the removal of more than 50 per cent of the leaf area prior to 15 days after unfurling.

Bunch characters in 'Palayankodan' were more influenced by the leaf pruning treatments imposed than in 'Njalipoovan'. In 'Palayankodan' no leaf pruning resulted in the highest number of fingers and bunch weight. The combined effect of the treatments revealed that removal of leaf area upto 25 per cent ~~leaf area~~ 15 to 30 days after unfurling help to retard the extent of yield reduction. The individual effects of the extent of leaf area removed and the time of pruning indicated that removal of 25 per cent of leaf area after 30 days of unfurling had less deleterious effect on the number of hands, fingers, bunch weight and yield per hectare.

The fruit characters such as fruit girth, weight and pulp weight in 'Palayankodan' were not significantly affected by

the combined effect of leaf area removed and the time of pruning. In 'Njalipoovan' the fruit weight and pulp weight were significantly affected. The individual effect of the pruning intensities had a more pronounced effect on the length, girth, weight and pulp weight of fruits. Removal of upto 50 per cent of lamina 15 days after unfurling had lesser deleterious effect on the above fruit characters.

The fruit quality of 'Palayankodan' especially the TSS and sugar content were affected to a greater extent than that of 'Njalipoovan' due to the combined effect of the treatments. The individual effects of the treatments also influenced the sugar content and the carbohydrate content. The green life of fruits was not significantly affected by the different pruning intervals. Retention of upto 50 per cent leaf area after 30 days of unfurling was a comparatively safe level of pruning for maintaining fruit quality in both the cultivars.

The combined effect of extent of leaf area removed and the time of pruning did not have a very marked influence on the content of major nutrients in the plant parts of both 'Njalipoovan' and 'Palayankodan'. However their individual effects were marked. With the increase in the severity of pruning, the content of major nutrients in the plant parts decreased. Removal of more than 25 per cent leaf area prior to

15 or 30 days of unfurling resulted in a lower nutrient content of the plant tissues in both the cultivars.

The maximum returns from fruits and the highest total returns per hectare were given by the control plants in which no leaves were pruned in both 'Njalipoovan' and 'Palayankodan'. If at all leaf pruning is to be taken up, it is desirable to prune only upto 50 per cent of the leaf area after 30 days of unfurling of the leaves. The net returns was higher in 'Njalipoovan' compared to 'Palayankodan'. Hence 'Njalipoovan' was found less affected by leaf pruning than 'Palayankodan' from the economic point of view.

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* Originals not seen

APPENDICES

APPENDIX I

Weather data during the growth and development period of banana cvs. Njalipoovan and Palayankodan

Month	Temperature (°C)		Relative humidity (%)	Rainfall (mm)	Cumulative rainfall (mm)
	Maximum	Minimum			
June 1993	28.90	24.12	81.99	132.30	132.30
July 1993	28.88	22.90	82.63	64.60	196.90
August 1993	28.40	23.73	79.88	11.10	208.00
September 1993	30.50	23.63	74.85	26.30	234.30
October 1993	29.86	23.36	78.06	100.00	334.30
November 1993	29.58	23.10	79.03	128.00	462.30
December 1993	30.30	22.78	74.81	65.70	528.00
January 1994	31.03	22.46	70.60	3.30	531.30
February 1994	31.10	22.98	67.43	11.80	543.10
March 1994	30.08	23.53	73.13	6.10	549.20
April 1994	33.18	24.53	75.43	7.80	557.00
May 1994	31.00	25.16	81.96	104.30	661.30
June 1994	29.90	23.95	78.40	57.00	718.30
July 1994	29.58	23.26	78.34	136.10	854.40
August 1994	29.60	23.75	76.30	186.30	1040.70

APPENDIX - II

Effect of leaf pruning on the cost of cultivation, net profit and benefit/cost ratio of banana cvs. Njalipoovan and Palayankodan

Details	Njalipoovan						Palayankodan					
	Control plants			Treated plants			Control plants			Treated plants		
	Rate	Number of labourers @ Rs.84/lbr	Quantity	Amount Rs.Ps.	Labour	Quantity	Amount Rs.Ps.	Rate	Number of labourers @ Rs.84/lbr	Quantity	Amount Rs.Ps.	Labour	Quantity	Amount Rs. Ps.
1. Clearing of land	@280 m^2/Lbr	36	-	3024.00	36	-	3024.00	@280 m^2/Lbr	36	-	3024.00	36	-	3024.00
2. Earthing up	@200 m^2/Lbr	50	-	4200.00	50	-	4200.00	@200 m^2/Lbr	50	-	4200.00	50	-	4200.00
3. Making irrigation and drainage channels (22 channels)	@400 m/lbr	6	-	504.00	6	-	504.00	@400 m/Lbr	6	-	504.00	6	-	504.00
4. Taking pits	@100 /Lbr	23	-	1932.00	23	-	1932.00	@100 /Lbr	23	-	1932.00	23	-	1932.00
5. Planting materials (Considering 5% mortality rate)	Rs.4/- per plant	-	2257	9028.00	-	2257	928.00	Rs.3/- per plant	-	2257	6771.00	-	2257	6771.00
6. Planting	200/ Lbr	11	-	924.00	11	-	924.00	200/ Lbr	11	-	924.00	11	-	924.00
7. Shading	200/ Lbr	11	-	924.00	11	-	924.00	200/ Lbr	11	-	924.00	11	-	924.00

Appendix II contd.

Details	Rate	NJALIPOOVAN						PALAYANKODAN					
		Control plants			Treated plants			Control plants			Treated plants		
		Number of labourers @ Rs.84/lbr	Quantity	Amount Rs.Ps.	Labour	Quantity	Amount Rs.Ps.	Rate	Number of labourers @ Rs.84/lbr	Quantity	Amount Rs.Ps.	Labour	Quantity	Amount Rs. Ps.
8. Compost/dry cowdung (10 kg/plant)	Rs.300/t	-	22.57t	6771.00	-	22.57t	6771.00	@Rs.300/t	-	22.57t	6771.00	-	22.57t	6771.00
9. Gap filling	-	1	-	84.00	1	-	84.00	-	1	-	84.00	1	-	84.00
10. Cowdung (dry)	@250 /Lbr	9	-	756.00	9	-	756.00	@250/Lbr	9	-	756.00	9	-	756.00
11. Irrigation after planting (for 1 month) Once in 3 days	@ 250 /Lbr	94	-	7896.00	94	-	7896.00	@250 /Lbr	94	-	7896.00	94	-	7896.00
12. Cost of fertilizers														
Urea	180 g/ plant @ Rs.2/90 per kg	-	387 kg	1122.30	-	387 kg	1122.30	100g/plant @Rs.2/90 per kg	-	215 kg	623.50	-	215 kg	623.50
SSP	180g/plant Rs.5/40 per kg	-	387 kg	2089.80	-	387kg	2089.80	200g/plant @Rs.5/40 per kg	-	430 kg	2322.00	-	430 kg	2322.00
MOP	360g/Plant @ Rs.4/- per kg	-	774 kg	3096.00	-	774kg	3096.00	400 g/ plant @ Rs.4/-	-	860 kg	3440.00	-	860 kg	3440.00

Appendix II contd.

Details	Rate	NJALIPOOVAN						PALAYANKODAN					
		Control plants			Treated plants			Control plants			Treated plants		
		Number of labourers @ Rs.84/lbr	Quantity	Amount Rs.Ps.	Labour	Quantity	Amount Rs.Ps.	Rate	Number of labourers @ Rs.84/lbr	Quantity	Amount Rs.Ps.	Labour	Quantity	Amount Rs. Ps.
13. Fertilizer application														
1 2MAP	@200 /Lbr	11	-	924.00	11	-	924.00	@200 /Lbr	11	-	924.00	11	-	924.00
2 MAP	@200 /Lbr	11	-	924.00	11	-	924.00	@200 /Lbr	11	-	924.00	11	-	924.00
14. Irrigation after fertilizer application (for 2 applications)	@ 200 /Lbr	11	-	924.00	11	-	924.00	@200 /Lbr	11	-	924.00	1	-	924.00
15. Irrigation during summer months (once in 2 days for 2 months)	@300 /Lbr	235	-	19740.00	235	-	19740.00	@300 /Lbr	235	-	19740.00	235	-	19740.00
16. Leaf cutting and transporting	-	-	-	-	64	-	5376.00	-	-	-	-	64	-	5376.00
17. Cleaning the channels	-	6	-	504.00	6	-	504.00	-	6	-	504.00	6	-	504.00

Appendix II contd.

Details	NJALIPOOVAN						PALAYANKODAN					
	Control plants			Treated plants			Control plants			Treated plants		
	Rate	Number of labourers @ Rs.84/lbr	Quantity	Amount Rs.Ps.	Labour	Quantity	Amount Rs.Ps.	Rate	Number of labourers @ Rs.84/lbr	Quantity	Amount Rs.Ps.	Labour	Quantity	Amount Rs. Ps.
18. Weeding (hand weeding) (4 times)	@500 m^2/Lbr	100	-	8400.00	100	-	8400.00	@500 m^2/Lbr	100	-	8400.00	100	-	8400.00
19. Desuckering	-	5	-	420.00	5	-	420.00	-	5	-	420.00	5	-	420.00
20. Phorate (75 g/plant)	@ Rs.55 per kg	-	161.25 kg	8868.75	-	161.25 kg	8868.75	@ Rs.55 per kg	-	161.25 kg	8868.75	-	161.25 kg	8868.75
21. Application of phorate (thrice)	@500/ Lbr	14	-	1176.00	14	-	1176.00	@500 /Lbr	14	-	1176.00	14	-	1176.00
22. Propping	@100 /Lbr	23	-	1932.00	23	-	1932.00	@100 /Lbr	23	-	1932.00	23	-	1932.00
23. Cost of propping materials	@ Rs.4/- /plant	-	-	8600.00	-	-	8600.00	@Rs.4/ /plant	-	-	8600.00	-	-	8600.00
24. Bunch covering with dry leaves (wrapping)	@100 /lbr	23	-	1932.00	23	-	1932.00	@100 /Lbr	23	-	1932.00	23	-	1932.00
25. Irrigation/watering	-	6	-	504.00	6	-	504.00	-	6	-	504.00	6	-	504.00
26. Harvesting and transporting	@100 /lbr	23	-	1932.00	23	-	1932.00	@100 /Lbr	23	-	1932.00	23	-	1932.00
27. Interest on working capital	@10% per annum			9913.19			10450.79				9920.93			10458.53
Total expenditure incurred				109045.04			114958.64				109130.18			115043.78

Appendix II contd.

Njalipoovan		L_0I_0			L_1I_1			L_1I_2			L_1I_3			L_2I_1		
Returns	Rate	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps.	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps.
1. Income from bunches	@Rs.6/- per kg	8.62	18533	111198.00	5.16	11094	66564.00	6.17	13265	79593.00	6.69	14383	86301.00	4.68	10062	60372.00
2. Income from sucker	@Rs.4/- per scuker	3.87	8320	33282.00	3.31	7116	28466.00	3.43	7374	29498.00	3.87	8320	33282.00	3.12	6708	26832.00
3. Income from leaves	@60 Ps per leaf	-	-	-	-	-	-	-	-	-	-	-	-	2.83	46934	28160.70
Total income				144480.00			95030.00			109091.00			119583.00			115364.70
Total expenditure				109045.04			114958.64			114958.64			114958.64			114958.64
Net profit/loss		Profit		35434.96	Loss		19928.64	Loss		5867.64	Profit		4624.36	Profit		406.06
Benefit/Cost ratio				1.32			0.83			0.95			1.04			1.00

Appendix II contd.

Njalipoovan		L_2I_2			L_2I_3			L_3I_1			L_3I_2			
Returns	Rate	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps.	Yie pl (kg
1. Income from bunches	@Rs.6/- per kg	4.83	10384	62307.00	5.29	11373	68241.00	3.19	6858	41151.00	3.91	8406	50439.00	5.
2. Income from suckers	@Rs.4/- per scuker	3.56	7654	30616.00	3.68	7912	31648.00	2.50	5375	21500.00	3.00	6450	25800.00	3.
3. Income from leaves	@60 Ps per leaf	20.67	44440	26664.30	20.65	44397	26638.50	21.16	45494	27296.40	20.58	44247	26548.20	20.
Total income				119587.30			126527.50			89947.40			102787.20	
Total expenditure				114958.64			114958.64			114958.64			114958.64	
Net profit/loss		Profit		4628.66	Profit		11568.86	Loss		25011.24	Loss		12171.44	
Benefit/Cost ratio				1.04			1.10			0.78			0.89	

Appendix II contd.

Palayankodan		L_0I_0			L_1I_1			L_1I_2			L_1I_3			L_2I_1		
Returns	Rate	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps.	Yield pl^{-1} (kg)	Yield ha^{-1} (kg)	Amount Rs.Ps.
1. Income from bunches	@Rs.5/- per kg	9.43	20274	101372.50	7.41	15931	79657.50	8.51	18296	91482.50	8.57	18425	92127.50	6.41	13781	68907.50
2. Income from suckers	@Rs.3/- per scukers	3.69	7933	23800.50	3.06	6579	19737.00	3.38	7256	21768.75	3.62	7788	23365.00	2.87	6160	18479.25
3. Income from leaves	@60 Ps per leaf													17.33	37259	22385.70
Total income				125173.00			99394.50			113251.25			115492.50			109772.45
Total expenditure				109130.18			15649.28			115043.78			115043.78			115043.78
Net profit/loss		Profit		16042.82	Loss		9070.28	Loss		1792.53	Profit		44872.00	Loss		5271.33
Benefit/Cost ratio				1.15			0.86			0.98			1.00			0.95

Appendix II contd.

Palayankodan		L_2I_2			L_2I_3			L_3I_1			L_3I_2			L_3I_2		
Returns	Rate	Yield pl (kg)	Yield ha (kg)	Amount Rs.Ps	Yield pl (kg)	Yield ha (kg)	Amount Rs.Ps	Yield pl (kg)	Yield ha (kg)	Amount Rs.Ps	Yield pl (kg)	Yield ha (kg)	Amount Rs.Ps.	Yield pl (kg)	Yield ha (kg)	Amount Rs.Ps.
1. Income from bunches	@Rs.5/- per kg	7.10	15265	76325.00	7.11	15286	76432.50	4.22	9073	45365.00	4.38	9417	47085.00	5.90	12685	63425.00
2. Income from suckers	@Rs.3/- per scuker	3.19	6853	20559.50	3.25	6972	20946.50	1.88	4031	12094.00	2.44	5246	15738.00	2.63	5644	16931.25
3. Income from leaves	@60 Ps per leaf	18.50	39775	23865.00	18.17	39065	23439.30	19.00	40850	24510.00	17.50	37625	22575.00	17.25	37087	22252.50
Total income				120749.50			120818.30			81969.00			85398.00			102608.75
Total expenditure				115043.78			115043.78			115043.78			115043.78			115043.78
Net profit/loss		Profit		5705.72	Profit		5774.52	Loss		33074.78	Loss		29645.78	Loss		12435.03
Benefit/Cost ratio				1.05			1.05			0.71			0.74			0.89

REGULATION OF LEAF PRUNING TO OPTIMISE LEAF AND BUNCH HARVEST IN MUSA (AB GROUP) 'NJALIPOOVAN' AND (AAB GROUP) 'PALAYANKODAN'

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ABSTRACT OF A THESIS
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ABSTRACT

The investigation on 'Regulation of leaf pruning to optimise leaf and bunch harvest in Musa (AB group) Njalipoovan and (AAB group) Palayankodan' was conducted at the Department of Horticulture, College of Agriculture, Vellayani, Thiruvananthapuram during 1993-'94 in order to study the effect of leaf pruning on growth, yield and fruit quality of 'Njalipoovan' and 'Palayankodan' bananas.

Studies revealed that the plant height in 'Njalipoovan' was comparatively less affected by leaf pruning than 'Palayankodan'. Plant height in both the varieties was higher with less severe pruning treatments. The plant girth, total number of leaves per plant and phylachron were not influenced by the leaf pruning regimes imposed. Leaf longevity increased slightly with the severity of pruning. 'Njalipoovan' responded more to leaf pruning than 'Palayankodan' with regard to leaf longevity.

The functional leaf area leaf area index and leaf area duration decreased significantly with the severity of leaf pruning in both the cultivars. Leaf pruning, after 15 days of unfurling, less adversely affected the relative growth rate in both the cultivars. The time taken for bunch emergence increased and the time taken for bunch maturity decreased, when the extent

of lamina removed was more or the period of retention was short, in both 'Njalipoovan' and 'Palayankodan'. The crop duration in 'Njalipoovan' decreased when the period of retention of leaves was longer.

The sucker production and dry matter production in both the cultivars were higher with lesser severity of pruning.

The bunch characters of 'Njalipoovan' were less adversely affected by the leaf pruning treatments imposed than 'Palayankodan'. The number of hands, fingers, bunch weight and yield per hectare in both the cultivars decreased with the increase in the severity of pruning. The finger length, finger girth, finger weight, peel weight, pulp weight and pulp/peel ratio of the fruits were also adversely affected by severe pruning treatments. Abnormalities in fruit shape and fruit filling were observed as a result of the leaf pruning treatments in 'Palayankodan'.

The fruit quality of cv. Palayankodan was more affected by severe pruning than that of cv. Njalipoovan. In both the cultivars, severe pruning treatments resulted in decreased quality in terms of TSS, reducing sugars, total sugars and sugar/acid ratio. The acidity of the fruits was not

significantly affected in 'Njalipoovan'. The non reducing sugar content and the green life of the fruits decreased with increase in the extent of leaf area removed but the time of pruning had no significant influence on these characters.

The content of major nutrients in the plant parts decreased with the increase in the severity of leaf pruning. The cost of cultivation was higher in the treated plants. The returns from fruits and the total returns per hectare was highest in the control plants. The net returns was higher in 'Njalipoovan' compared to 'Palayankodan'.

The studies thus indicated that in general, leaf pruning was not a desirable practice from the economic point of view in 'Njalipoovan' and 'Palayankodan'. However, the loss of lamina upto 50 per cent after 30 days of unfurling had less deleterious effects compared to more severe loss of leaf area. 'Njalipoovan' exhibited more ability to withstand the adverse effects of leaf pruning than 'Palayankodan'.